TECHNOLOGY DEPT.

Gas Journal

VOL. 287. 108th YEAR. LONDON, JULY 18, 1956. No. 4853. PRICE 1/6

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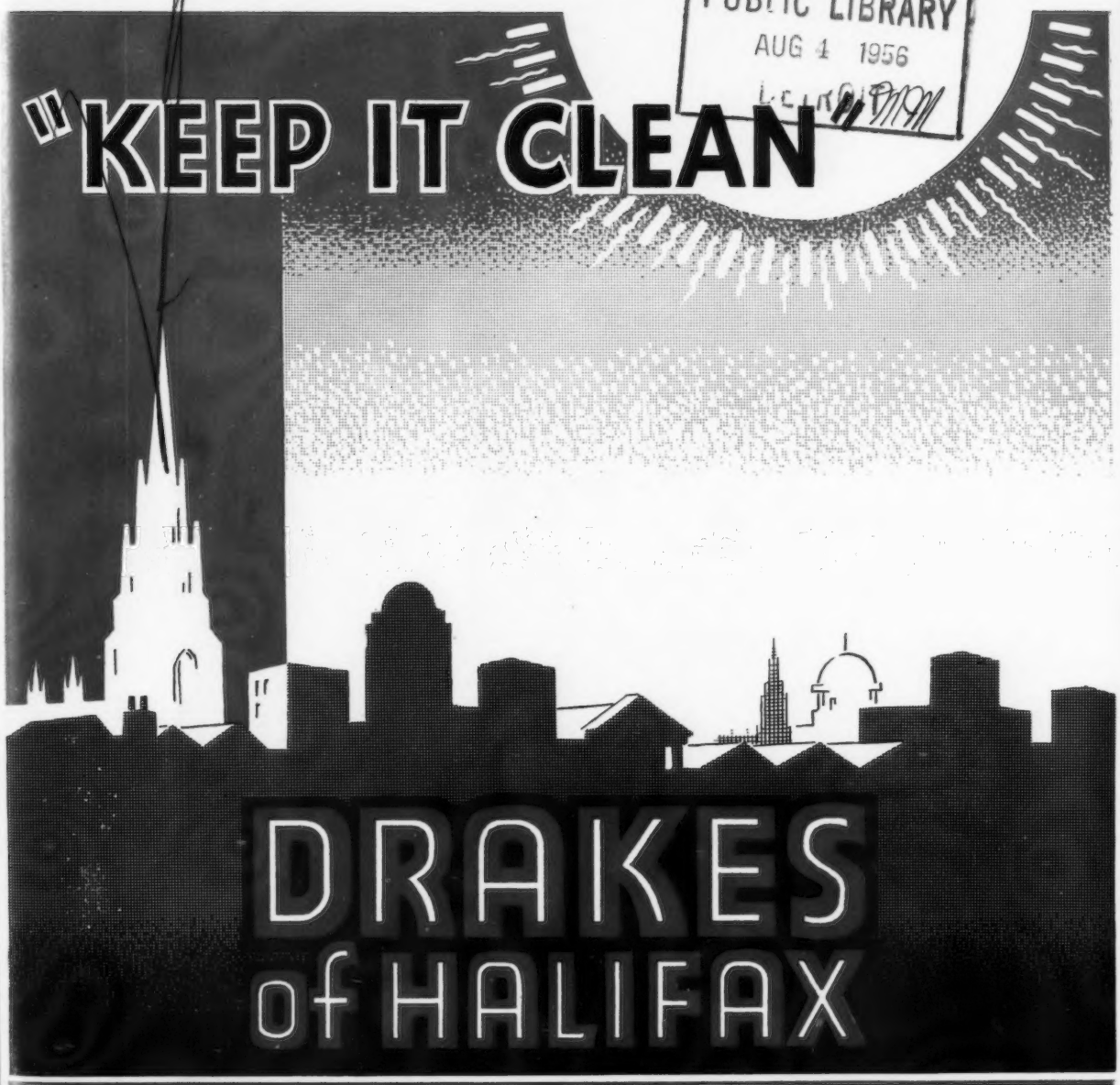

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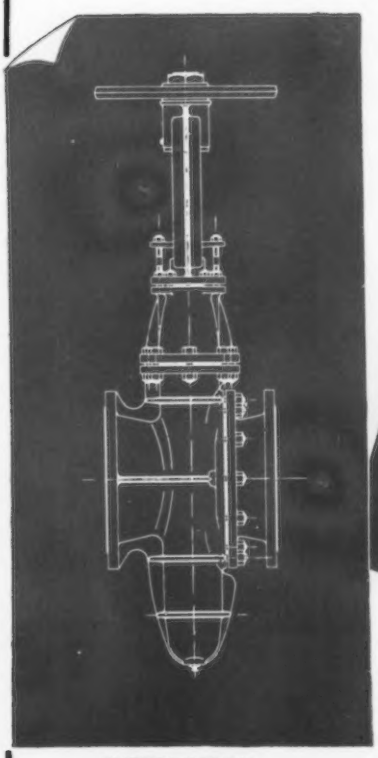
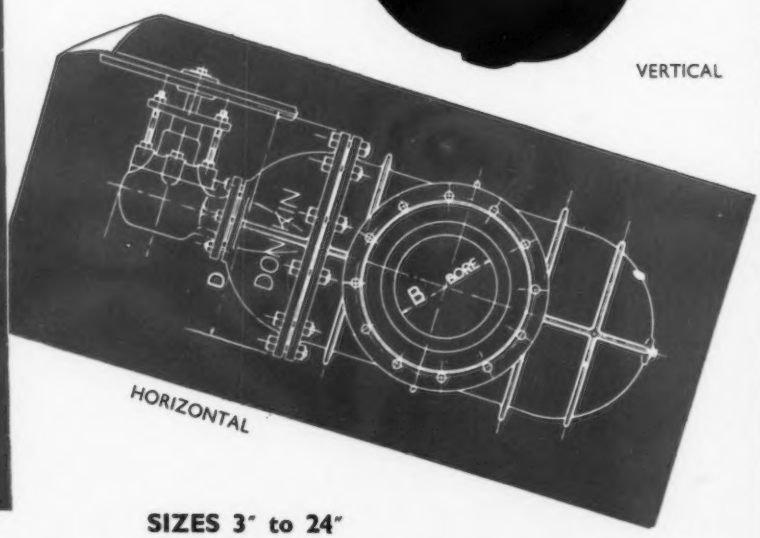


OUTSIDE SCREW



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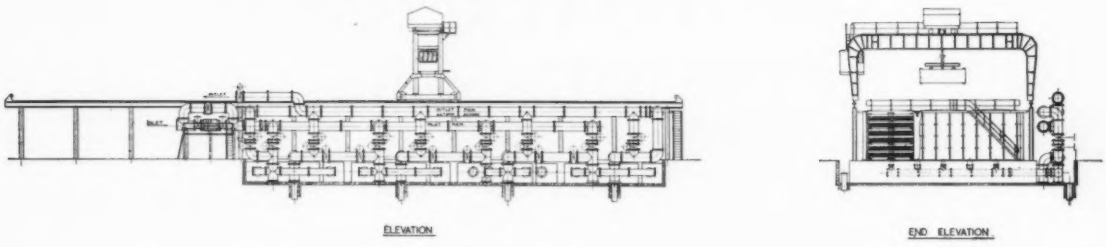
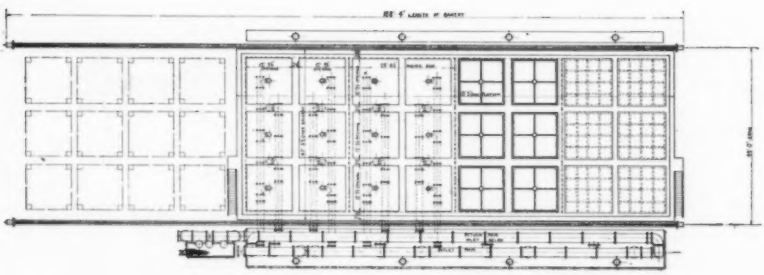


ELEVATION

END ELEVATION



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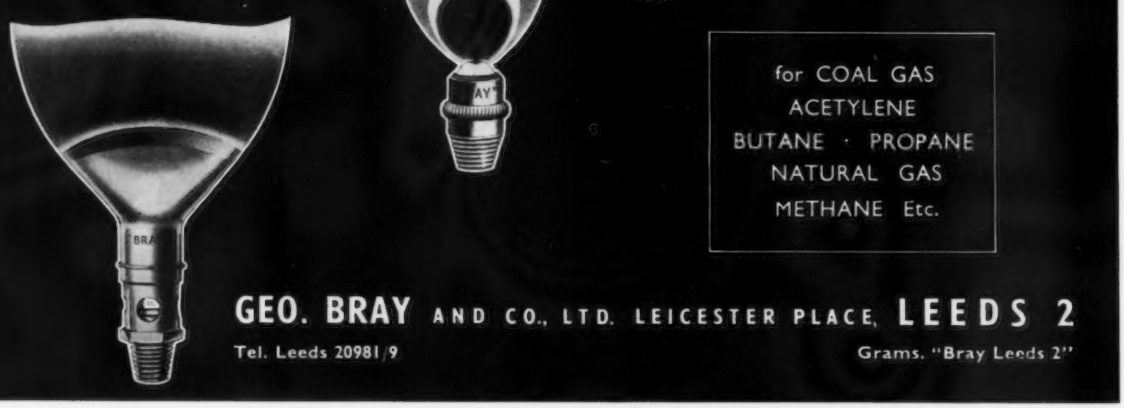

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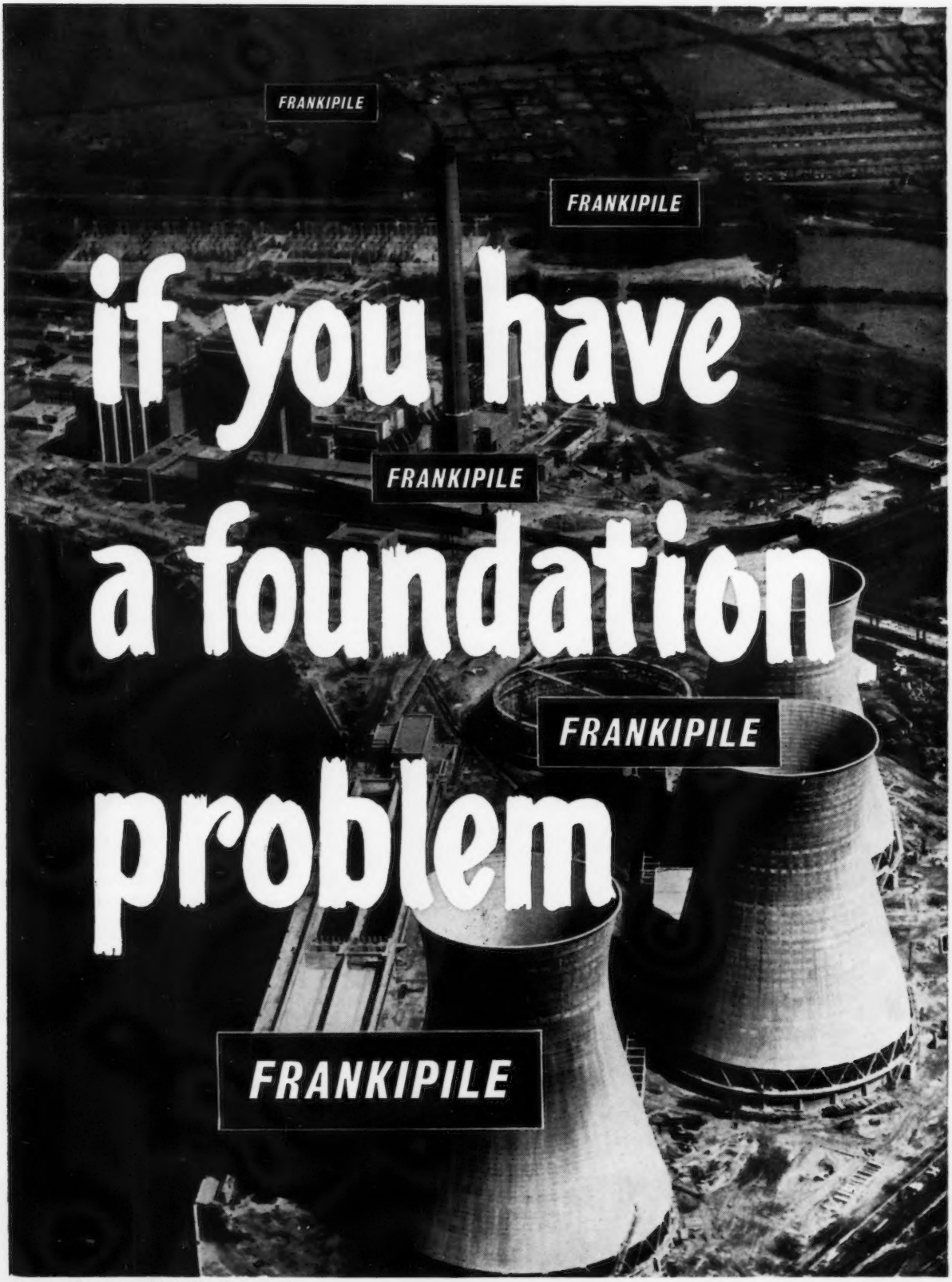

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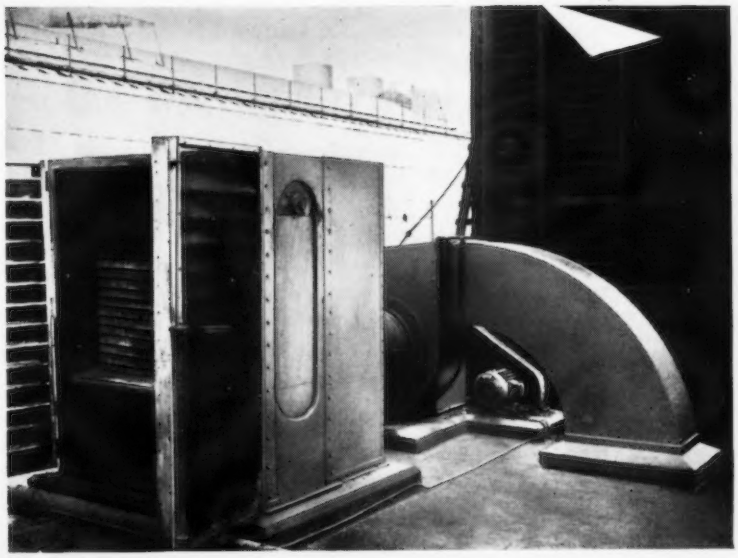

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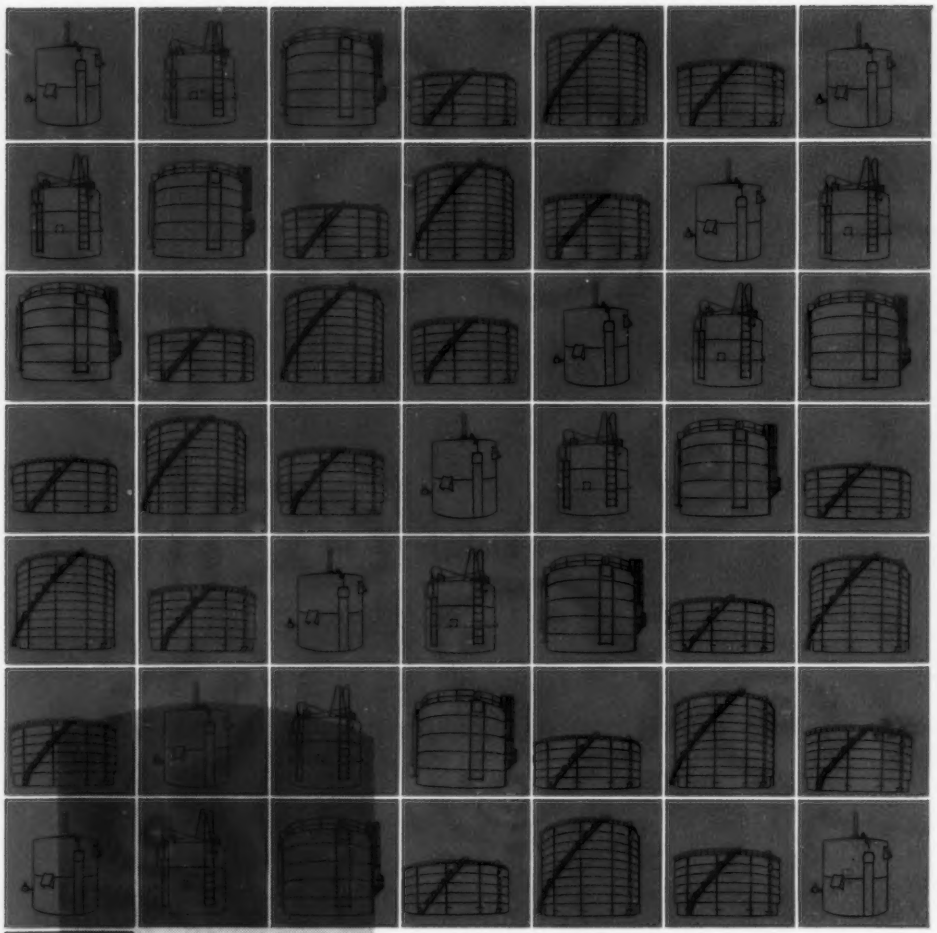
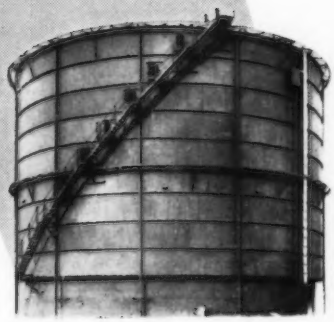


The Wiggins Dry Seal Gasholder



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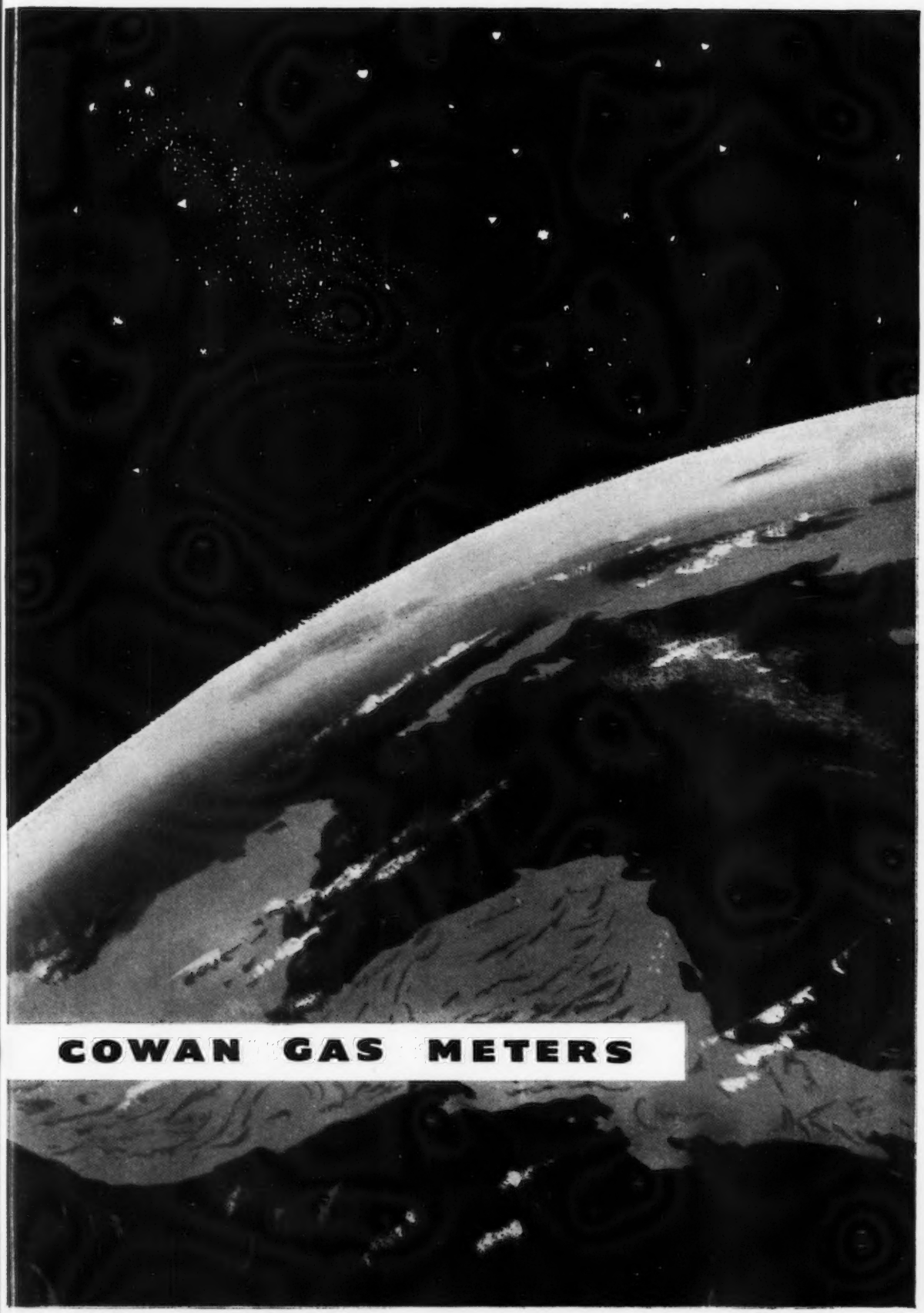
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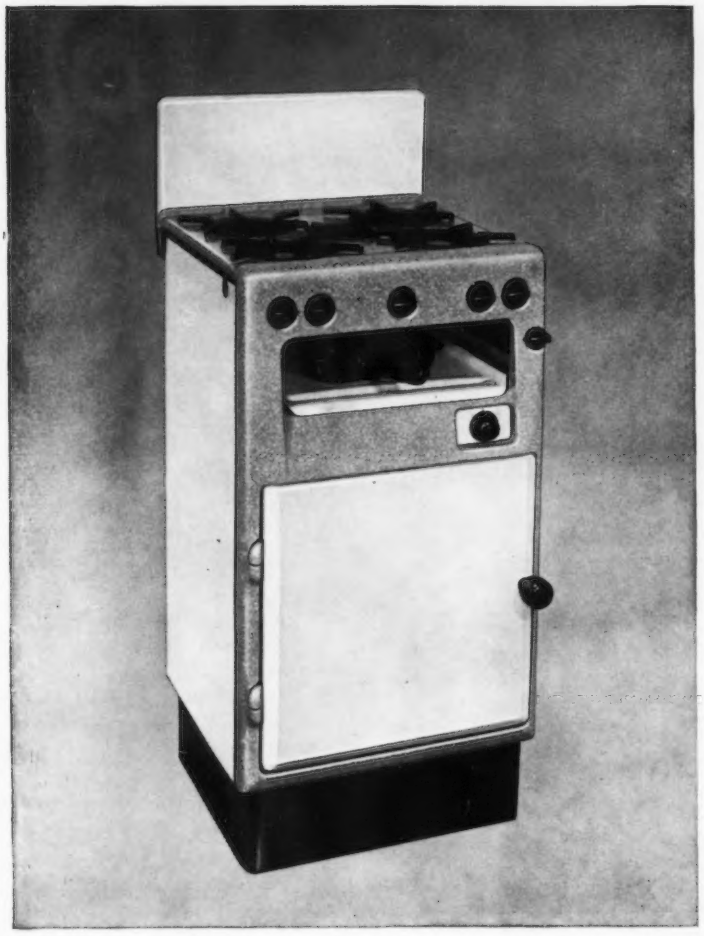

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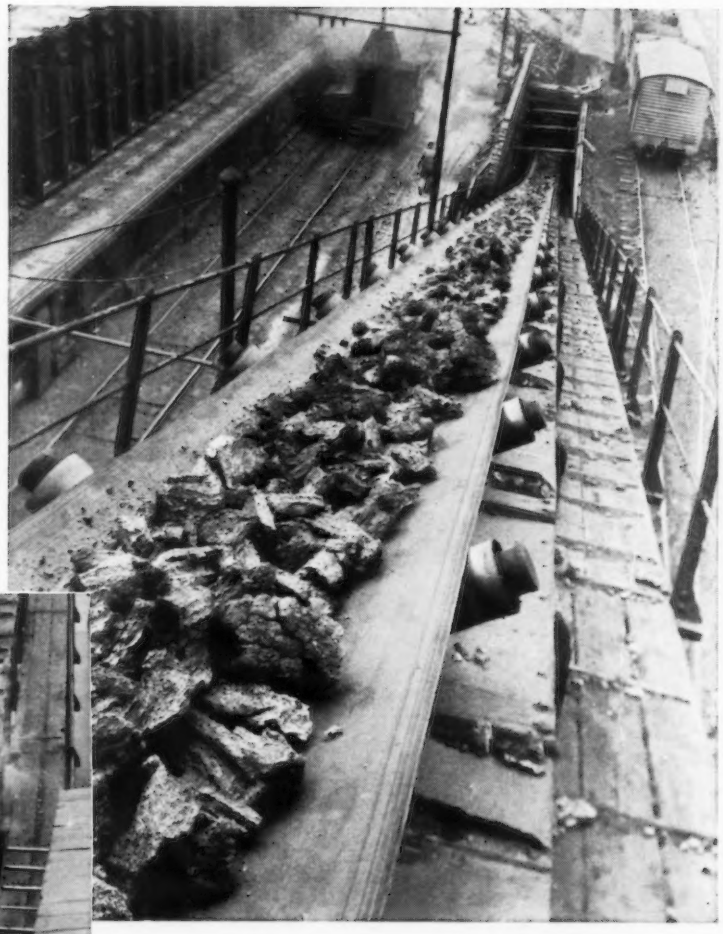

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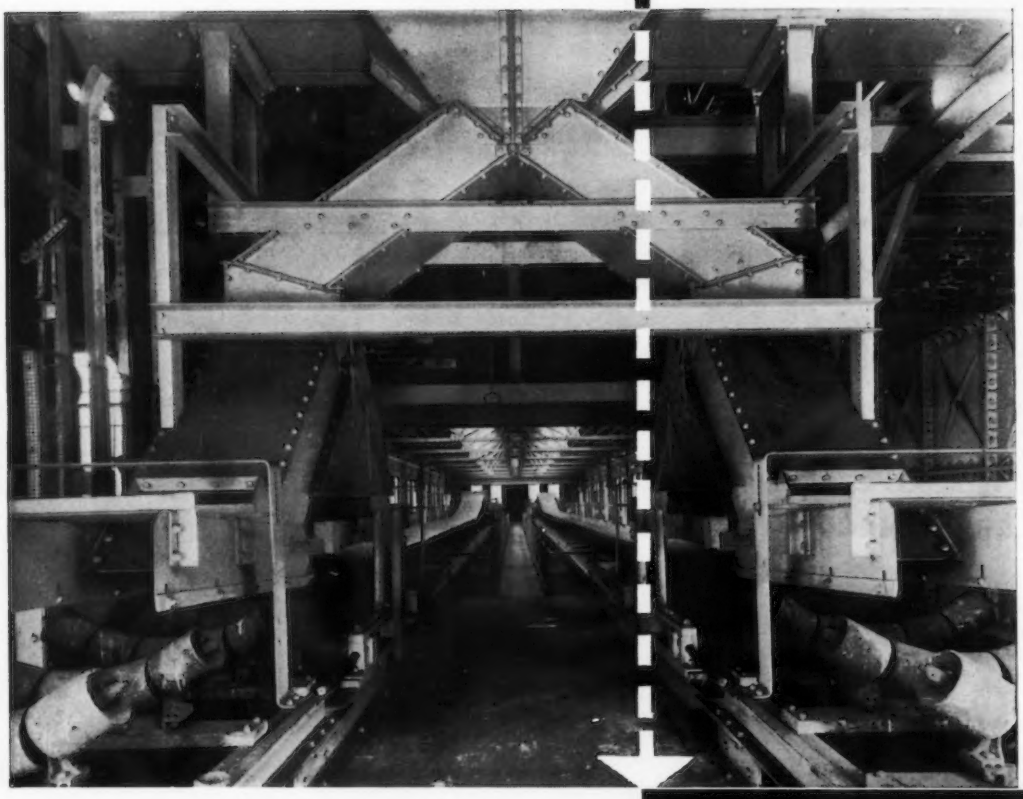

Wigan Overhead Coal Belt Conveyors. Photograph by courtesy of The North Western Gas Board and Drakes Ltd. of Halifax.

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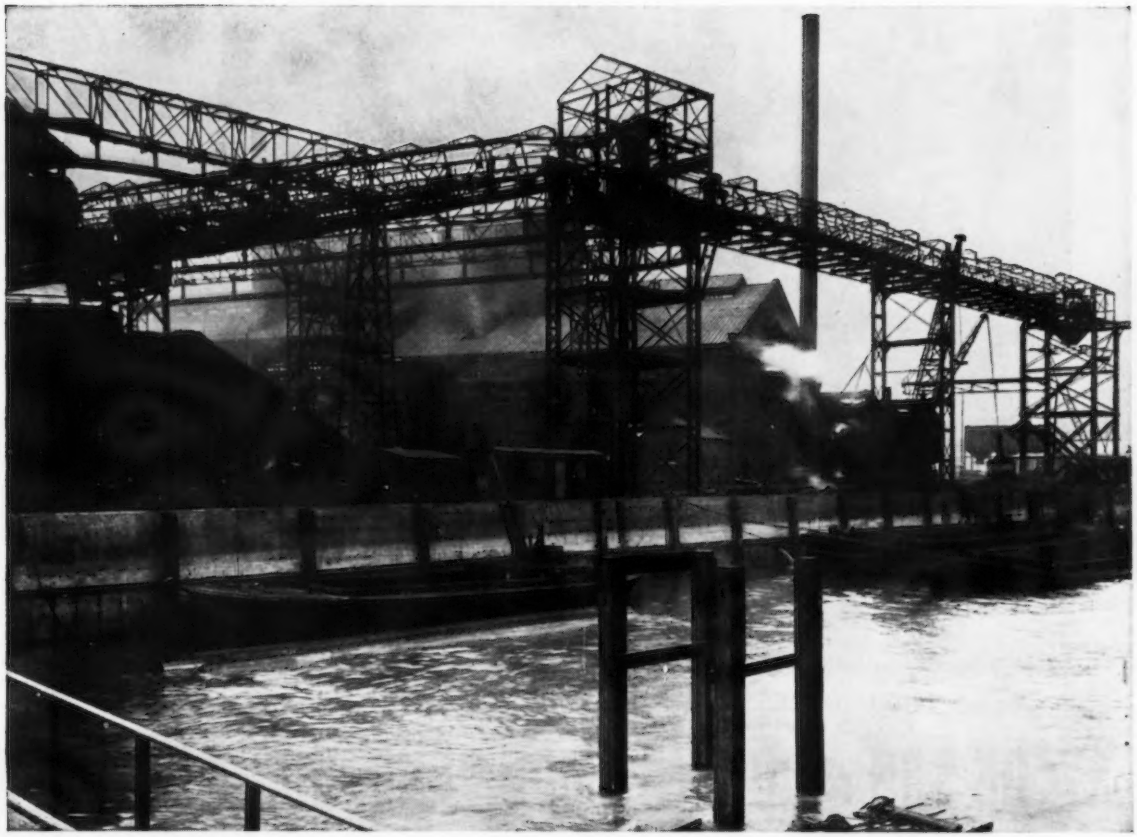

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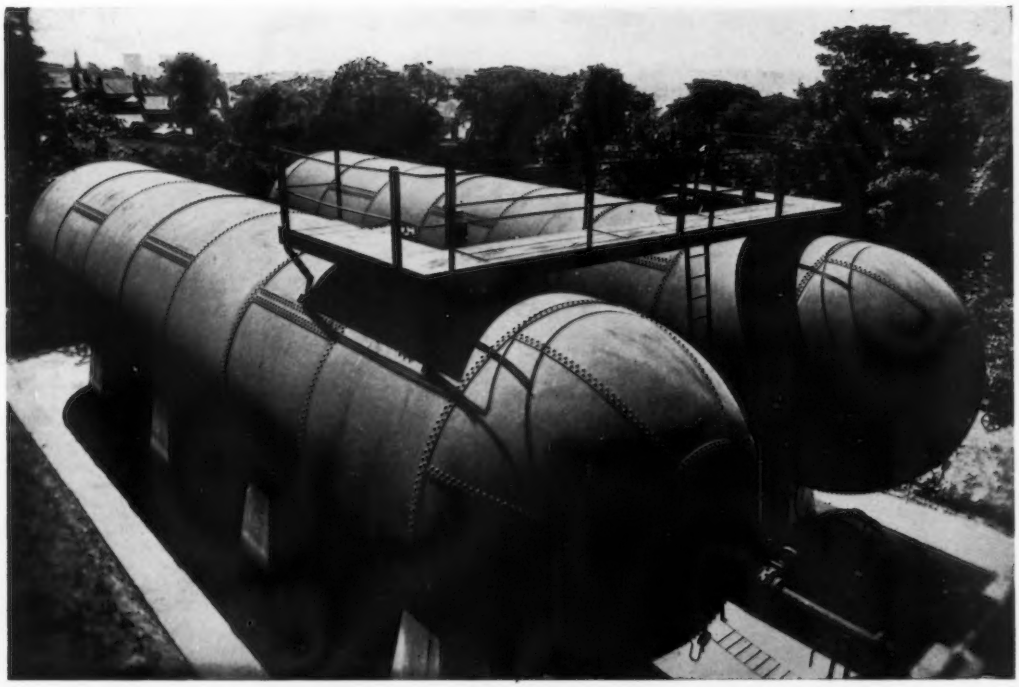

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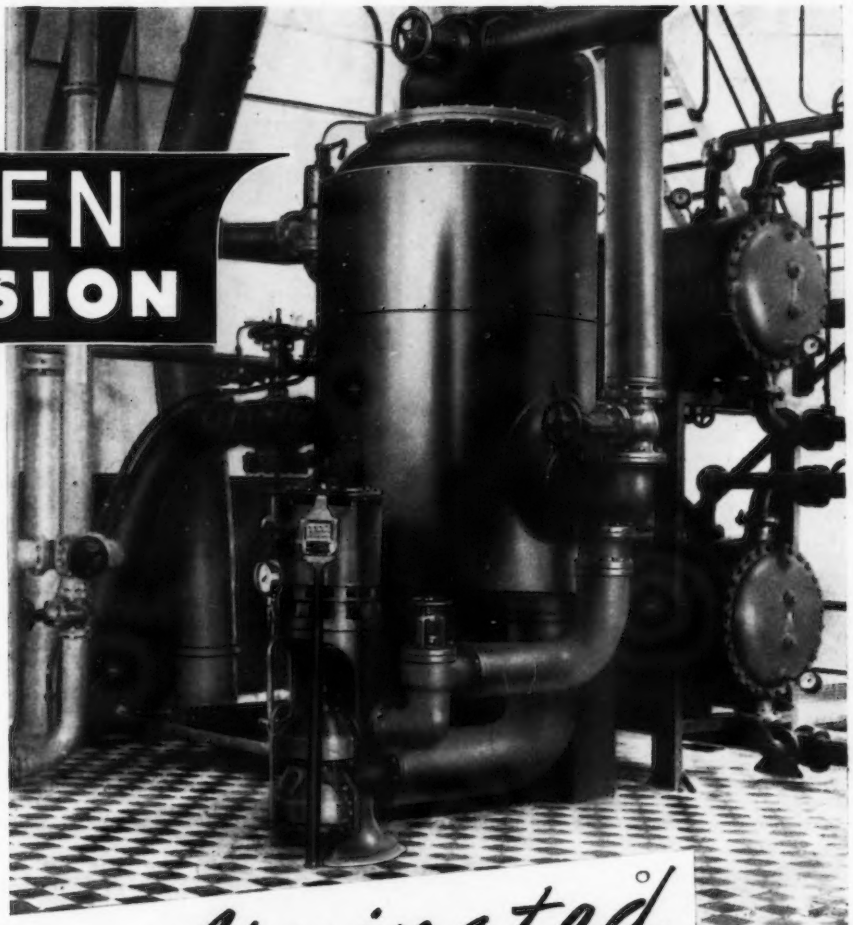
OXYGEN CORROSION



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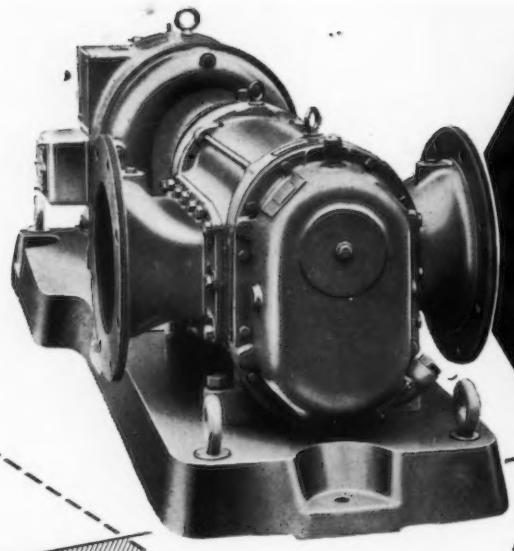

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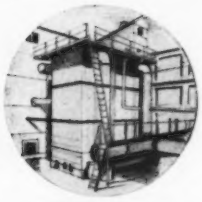

- WASHERS
- SCRUBBERS
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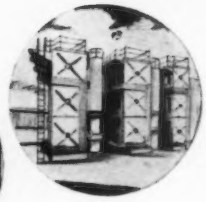

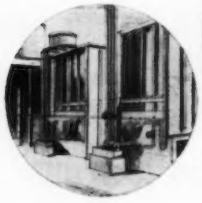

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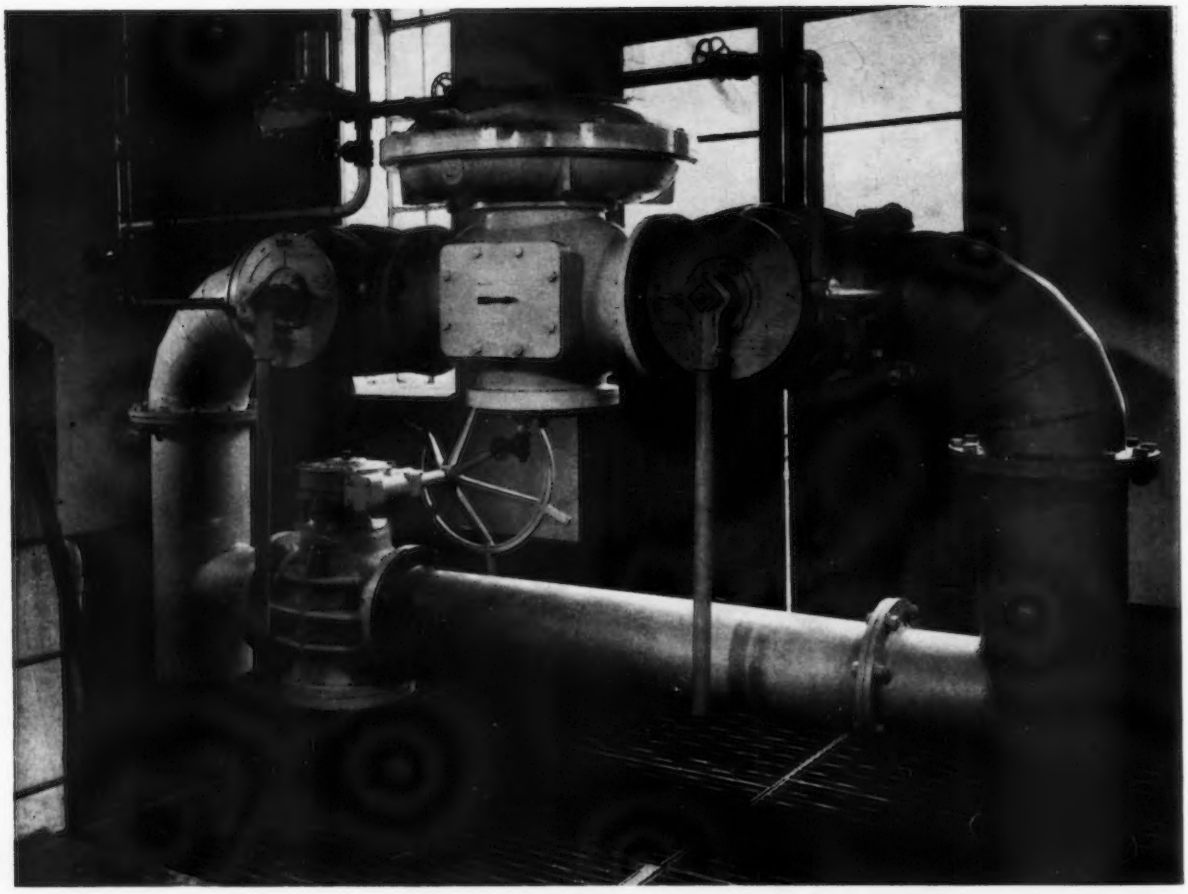

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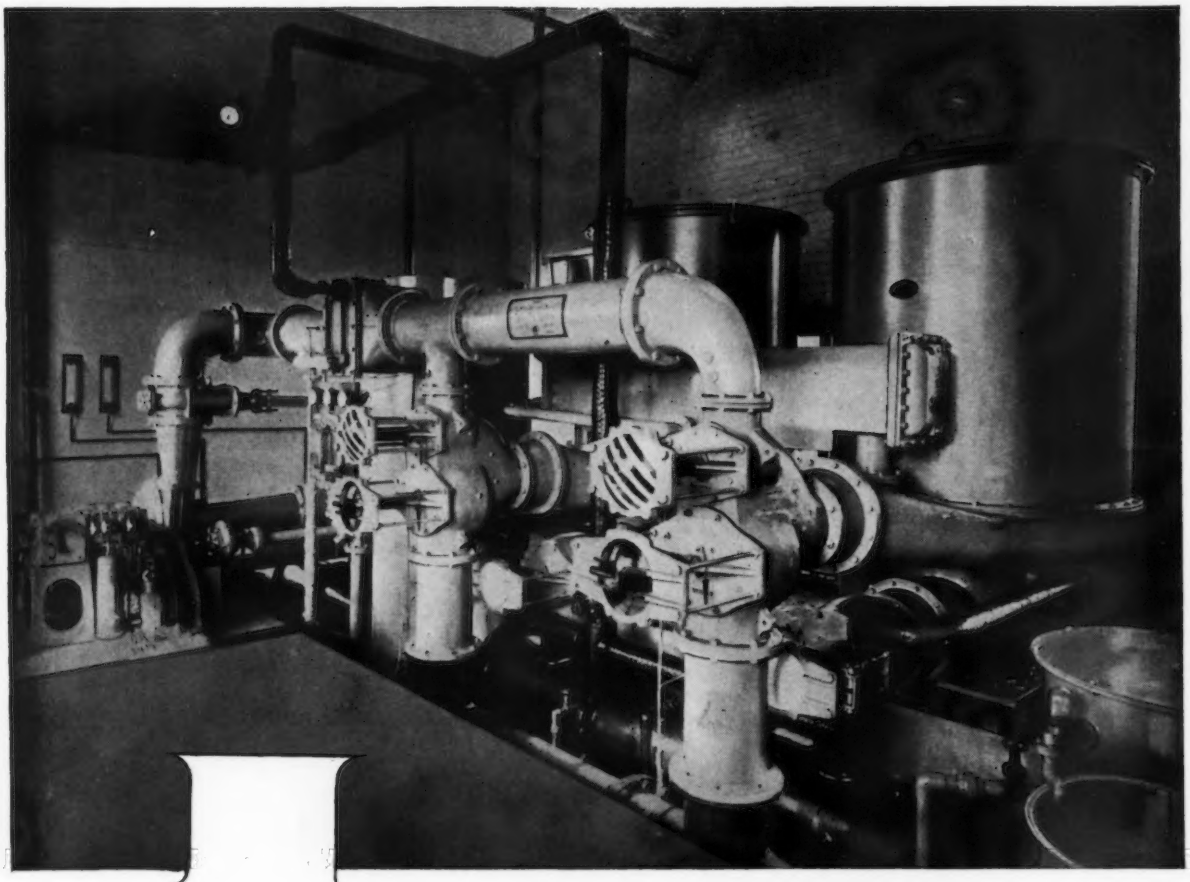

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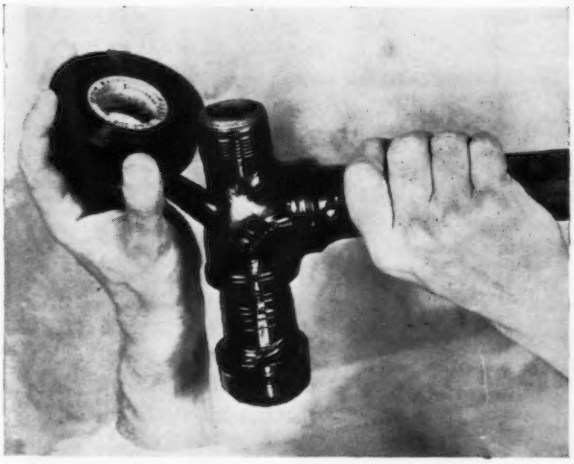

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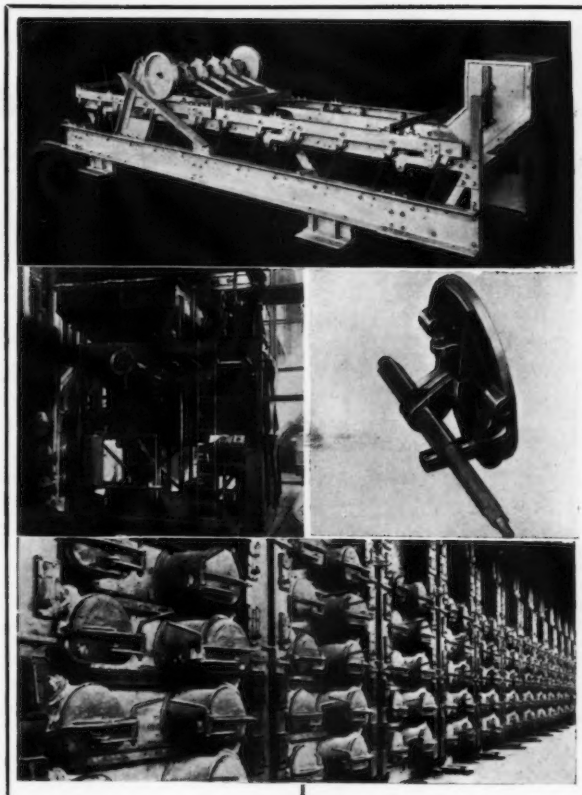

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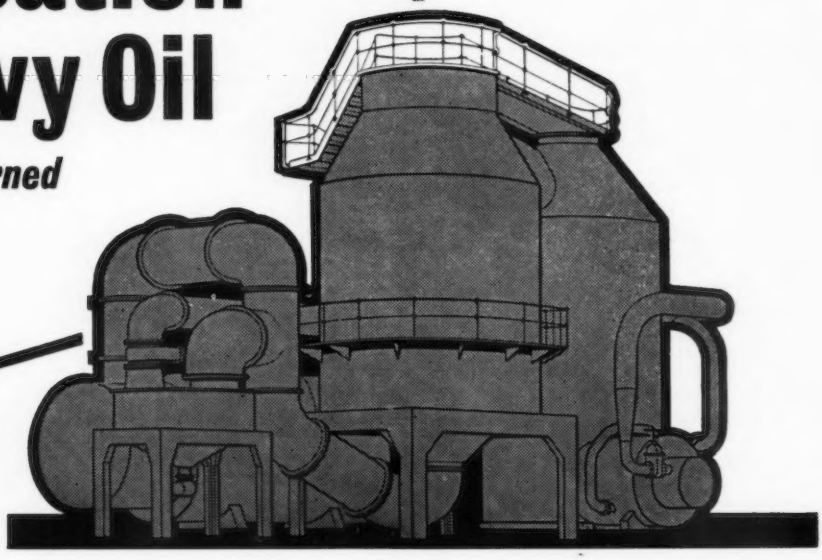

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Gas Journal

VOL. 287 NO. 4853 July 18, 1956

108TH YEAR

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Gas Journal

VOLUME 287. No. 4853. JULY 18, 1956. 108th YEAR

Sunbeams on the Editor's Desk

THOSE who travel to and from their work by train must notice how, during July, August and early September, the absence on holiday of regular passengers makes a surprising improvement in the amount of room available. Clearly the percentage of people holidaying at the same time is very considerable, and yet the business world goes on much as usual. Milk continues to arrive on our doorstep, cigarettes are still stacked on the tobacconist's shelves, and only under conditions of emergency do the pubs run dry. Equally, no stories have reached us of any failure in gas supplies due to labour shortage during the holiday period. Yet the gas industry does take a holiday—we have the reports of our friends to prove it. Gas engineers forsake the stern surroundings of their works and offices in order to take their wives and cars abroad, play golf, or even, we have heard it said, build sand castles. Some sections of the industry may actually work harder during the summer months—those whose works are at coastal resorts, for example, where the profits go up as the holders go down. On the sales front a burst of sunshine and a touch of food poisoning results in an upward surge of refrigerator sales. For Mr. Therm's motto is 'Business as Usual' and the Technical Press, which faithfully mirrors the industry's activities, follows suit. The Institution sections and Junior associations have ended their sessions in a blaze of glory and, we hope, sunshine; among the Salesmen's Circles members have bidden each other *au revoir* until September or thereabouts. But the Technical Press carries on regardless. The 'GAS JOURNAL' continues to arrive on the reader's doormat with its customary weighty thump, or loiter (we trust invitingly) in his 'IN' tray, awaiting, perhaps, his return from Majorca or Minehead.

However, the bloom of summer and the scents and stirrings of haymaking and harvest penetrate even into the dark corners of Bolt Court and set editorial minds wandering, butterfly-like, after the flirtatious July sunshine. Our thoughts become deflected from the careful examination of individual matters of importance and veer towards a somewhat dreamy contemplation of many things, some of them seen, as it were, for the first time in a changed perspective.

It is, of course, a truism that the grass appears to grow greener in the next field and the neighbour's fruit seems sweeter than one's own. So it strikes us that there may be more doing in other industries than in our own, despite the exciting developments of which we heard so much during Institution week and later at the World Power Conference. Oil is consistently making news. The Royal Dutch-Shell Group is studying plans to build a major pipeline for crude oil in Western Europe. The trunk line would run from Marseilles through Eastern France, Luxemburg, the Saar, Western Germany, Holland and Belgium to the North Sea ports of Rotterdam and Antwerp. A fascinating conception and one which immmediately raises the question of pipeline versus tanker, a matter which is complicated by the fact that the cost position is constantly changing. Two years ago the Institute of Petroleum suggested that if a large diameter pipeline (30 in.) were used to its full capacity, its costs per ton-mile would be double those of a 32,000-ton tanker; smaller diameter pipelines would have appreciably higher costs. But the whole business is extraordinarily complex, being bound up with wayleaves, power costs, corrosion, and many other factors. What has this to do with gas? That remains to be seen, but the item is worth mentioning now as being a possible major development in the European fuel picture.

In this country we understand that the recently completed extension of the Shell Mex and B.P. installations in Worcester is a reflection of the increasing consumption of oil fuels in the Midlands for transport, heating and industrial purposes; indeed, Worcester is now stated to be one of the most important inland ports in the country. But this is only one of 20 distribution projects to be completed at a cost of £2.75 mill. and work is in progress at another 16. What does this mean? Probably that oil prices will tend to rise (in order to cover investment) and there will be a fresh onslaught on solid fuel and gas at both industrial and domestic levels.

Over in the coal camp tempers are a mite frayed. First there was the Coal Board's announced policy of stabilizing coal charges, a good resolution which has also been adopted by electricity and gas. But then came the National Union of Mineworkers' reaction, expressed at their annual conference in the stern tones of Mr. Arthur Horner, who said that if price stabilization meant the restriction of the miners' justified demands (whether justified or not the demands are formidable), then they would oppose it. Meanwhile the Government is having a spot of bother with its Coal Industry Bill

and it has been suggested that the Minister of Fuel and Power must submit an Order to the House each year setting out the Board's financial requirements for the coming year; two White Papers to be published and debated annually have also been mentioned by Conservative back benchers. A small voice belonging to Brigadier Clark, a supporter of Mr. Nabarro, was raised in the House a few seconds before the Bill received its third reading. He said: 'I have absolutely no confidence whatsoever in the Coal Board, none in the Minister, and absolutely none in the miner, and I reckon I speak for 75% of the country, including all the housewives.' And he might be right at that—a sobering thought!

Our other fuel neighbour, electricity, is pressing on with its generation programme with determination and appears to find nothing comical in the fact that a gasworks such as that at Denton (which will be the subject of a special 'JOURNAL' feature next week) can feed electricity, produced from waste heat, into the grid. Electrical appliance development is to be taken very seriously indeed, and just as a possible foretaste of things to come may we instance the production in the States of an electronic kitchen stove that cooks through the medium of high-frequency microwaves. It is said to cut the time for cooking by from 30% to 90% according to the food item. Microwaves heat only the food itself, and not the utensiles containing it.

Taken all round, the pictures which form in our mind as we submit to the blandishments of the summer temptress are vaguely disturbing. We keep thinking of all those worthy members of our industry disporting themselves on the sands or enjoying their no doubt well-earned holidays in ways peculiar to their tastes and pockets. Maybe they ought to pack up and come home.

The Collin Coke Oven

ON a later page we publish excerpts from a paper describing the Collin coke oven. Ovens of this design have been in operation for some years in this country, although they are found mainly on the Continent. The system of heating is unique and it had not been fully described in English until Mr. M. S. Gaskill did so in his paper presented to the Coke Oven Managers' Association. A shortened version of this paper appears in the current issue of *West's Gas*.

With the advance in iron and steel production in the 1920's the present day big-capacity coke oven was developed. It gave rise to problems in the stability of the walls and in the even heating of the charge from top to bottom. The solution of the latter problem put forward by Collin is of considerable technical interest. It ensures, to quote Mr. Gaskill, 'that the heating wall is subjected at all times to constant combustion conditions, preferably what has been described as primary combustion, i.e., combustion of the fuel gas with the correct amount of secondary air in one stage only.' It is natural that this principle should be attractive to the designers of the West 'balanced heating system,' since it is implicit in that design for the heating of their continuous vertical retorts. Mr. Gaskill goes on: 'Lecocq estimated that in a coke oven 94% of the heat of combustion is transferred to the walls of the up-going chamber in which initial combustion takes place.' Any secondary combustion with additional secondary air may extend the length of flame, but its effect is dulled by the presence of products of the combustion at the initial point.

In the Collin system fuel gas is admitted alternately from the bottom and from the top—'the whole wall is continually be-flamed.' In the upward heating stage the waste gases return downward, and in the downward stage the secondary air and fuel gas pass upward, in passages formed by hollow tiles in the heating flues. These tiles materially strengthen the construction.

As in its other application the use of primary combustion only, as well as the maintenance of even temperature distribution, enables the necessary temperature of the charge to be obtained with a relatively low combustion chamber temperature, a further important factor in the life of the refractories; excessive local heating is avoided while it is claimed that uniform heating of the walls can be obtained with chambers up to 6 metres high, with consistent 'coking characteristics' throughout the charge. A further interesting point is that as the burning fuel gas is not passed over the top of the ovens, overheating of the gas collection at the top of the oven cannot occur, thus avoiding degradation of the make gas and the formation of excessive naphthalene.

Associated with this design is the Collin system of dry cooling for the coke which was fully described by Mr. A. E. Morris in his recent communication to the Institution of Gas Engineers. Both this and the Collin oven itself are indeed well worthy of re-examination in the light of the present-day fuel situation.

The Effluent Problem

IN the extract from the paper by Mr. J. K. Lord, of Stockport, which we publish in this issue, can be found a description of the plant being installed at the Portwood Works, Stockport, of the North Western Gas Board, to render the gasworks effluent liquor acceptable for disposal in the local River Board's area. This is a problem which will be facing, if it is not already doing so, a great many gas undertakings. The conditions laid down by the Ministry of Housing and Local Government may seem severe compared to the more easy-going attitude of the owners of gas undertakings and the local authorities in the past but, as Mr. Lord points out in an introduction to his paper (which shortage of space unfortunately prevents us from publishing) even as long ago as 1920 the Gas Committee of the Borough of Stockport were having difficulties with the River Board over the disposal of gasworks effluents. A temporary measure was to allow the effluent to filter through a mass of earth and ashes, which appeared to be reasonably effective in absorbing the more obnoxious elements of the effluent. The original trouble appears to have been caused by ceasing to manufacture sulphate of ammonia, because the fall in price had made it uneconomic to do so, raw liquor taking the place of spent liquor effluent. In 1939 complaints were again received by the Gas Committee, but the coming of the war temporarily caused the matter to be shelved.

After the nationalisation of the gas industry in 1949 matters began to become serious and finally came to a head in 1951 when the River Board informed the Gas Board that they could no longer tolerate the pollution of the river Tame. In the meantime, efforts to gain

permission to dispose of the effluent into the public sewers had failed, due largely to an excessive price being asked by the Local Authority.

Finally in 1951, deadlock was reached and a notice was served on the Stockport Corporation by the Board's solicitor, stating the Board's intention of connecting the gasworks sewer to the public sewer. The Sewage Committee refused to accept this effluent and as a result of an appeal by the Board to the Ministry of Housing and Local Government, a Court of Enquiry was held.

This has involved the building of a concentrated ammonia plant which confines the effluent once more to spent liquor. The plant is of up to date design and automatically controlled and fortunately makes a small profit, thanks to a demand for concentrated ammonia.

It is certainly a costly business to make gasworks effluent innocuous, but it is a sign of the times that a stop is being made to the reckless pollution of some of our rivers, which so short a time ago was considered inevitable, and too expensive a problem to be solved. Perhaps as has happened in other industries in the past, not only will virtue be made of necessity, but a handsome profit made at the same time.

Gas Boards Are Vulnerable

THE right of the humblest customer to protest against a nationalised industry is, of course, a thing to be preserved, but inevitably there are times when the industry is used as a large, sitting target by anyone with a few darts to spare. Such a situation appears to have arisen in last week's spot of bother in which the Minister of Fuel and Power was advised to take disciplinary action against the North Western Gas Board because of its alleged treatment of a customer, Mr. B. Herdan, of Millom, who had complained about a delivery of coke. The minority report of the Industrial Coal Consumers' Council accused the Board of having threatened to deprive Mr. Herdan of further supplies of coke and of having treated him discourteously.

The report, addressed to Mr. Aubrey Jones, said: 'It will be noted that one of the first reactions of the Gas Board was to threaten to withhold supplies. There follows a long series of unsatisfactory and evasive and even rude letters, and even now, to the best of my knowledge, Mr. Herdan has had no satisfactory answer to his letter. I am of the opinion that this case is evidence of mal-administration on the part of the North Western Gas Board and calls for disciplinary action.' The report was signed by Lieut.-Col. P. W. Robinson, a member of the Council, and it referred to the Council's last three meetings.

Mr. D. P. Welman, Chairman of the Board, was reported by the *Manchester Guardian* as refuting Colonel Robinson's implication that the Board would at any time deal with its customers other than in a manner in every way courteous and in accord with normal business practice. Taking up Colonel Robinson's statement that one of the first reactions of the Gas Board was to threaten to withhold supplies, Mr. Welman said: 'This implies that we would use such action as a weapon in argument, but no officer in this area either would make, or has at any time made, any suggestion of the kind.' He said that refusal of supplies only normally arose from failure to pay for supplies already received. He had looked through the whole of the correspondence, and in no single communication could anyone suggest that the wording was not in any way courteous. At no time had Colonel Robinson been in touch with him or any officer of his Board with regard to the subject matter of his letter. 'Misleading letters of this kind presented under conditions of privilege can be most disheartening to many thousands of hard-working officers and men who so conscientiously serve both the Board and this industry,' said Mr. Welman.

From what we know of the evidence we endorse Mr. Welman's defence of his staff and the service given by his Board. It appears likely that Mr. Herdan did indeed receive the deliveries of saturated coke of which he complains, but equally there seems little doubt that he was treated fairly and courteously by the Board. In the circumstances it would be unfortunate if the Minister attached too much importance to the affair.

Chain Reaction

HOW meekly and uncomplainingly we accept the many changes in our lives which are foisted upon us under the guise of 'improvements'! All too often they are not improvements at all but distortions and travesties, coarsening and retrogressive. And how refreshing, therefore, to hear of the stout-hearted minority, true to their higher instincts and convictions, who raise their voices in protest, even if they are subsequently silenced by the steam-roller might of 'progress' or whatever other glib name is used. Such a defender of the faith was Mr. Arnold Machin who last week chained himself to one of the old gas street lamps at the Villas, Stoke-on-Trent, in protest against their replacement by concrete electric standards.

His action, he said, was a protest against 'all the beautiful things in this country being destroyed.' After he had been spoken to by the police, he said that he had done sufficient to make his protest and asked his wife to unchain him. Workmen then began to dismantle the old lamp standard. Mr. Machin said that he felt he had achieved partial success because he was going to buy the lamp which was now to be preserved. It had been intended previously to break it up.

A pleasing story is it not? One to brighten Suggian hearts in Westminster. But perhaps the most heartening thing about it is that it was reported in *The Times*! Our one regret is that unlike the Avenue des Champs-Elysées, the Villas are not to retain their gas lamps, reinforced by electric lamps. We suppose it is stretching the imagination too far to expect Stoke to emulate Paris.

All Mod. Con.

WE recall, very soon after nationalisation, meeting Mr. K. L. Pearce and Mr. J. Corrigan in one of the entrances to the Victorian structure in Millstone Lane, Leicester, which the East Midlands Gas Board and inherited from the Local Authority. The entrance was as good a spot as any for a chat, for things were pretty congested inside—Board level, Divisional level, undertaking level, with some measure, we believe, of infiltration. Since then a wand has been waved and the pumpkin has turned into a Cinderella's coach; the whole transformation having been wrought by skilled tradesmen of the Leicester and Northants Division in co-operation with certain artists from headquarters. Old walls have been hidden or disguised, dreary old offices have become bright and inviting, and in one quarter an externally added corridor has been engineered to provide quiet and light for what was once shut off by solid wall. Only when interviewed by Mr. J. H. Brooke, Assistant General Manager, might the newcomers guess at a metamorphosis, for the floor of his fine office is mosaic—we suspect it was once part of the first floor landing, where there would have been the leather covered settee, the fire extinguisher, and the aspidistra. The décor throughout is of the contemporary multicolour type of wallpapering and washes, and very good it is. We had seen it in bijou residences and in restaurants, and felt doubtful; applied to a large Victorian office block it has our fervent admiration. We wonder if the East Midlands Gas Board would give us a quote for No. 11, Bolt Court.

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Personal Notes

MR. W. F. PRITCHARD has been appointed Assistant Industrial Relations Officer to the Eastern Gas Board. He was recently elected Junior Vice-President of the Eastern Junior Gas Association.

MR. ARTHUR G. CRANMER, Engineer and Manager of the Willenhall, Staffs, gasworks, is leaving to become Station Engineer at Stourbridge. His father, MR. WALTER G. S. CRANMER, who is now approaching his 85th birthday, went to Willenhall in 1893 to design and plan the works of which he became Manager, later becoming Managing Director of the old Willenhall Gas Company until nationalisation.

MR. GEORGE EWART has joined Aquafont Industries Ltd., 35, Kentish Town Road, N.W.1 (a member of the Ewart Holdings Group), as Director and General Manager. Aquafont Industries Ltd., specialize in the manufacture of catering equipment.

MR. H. W. G. HIGNETT has been appointed Assistant Managing Director to Henry Wiggin and Co. Ltd., producers of high nickel alloys in Birmingham, Glasgow, and Hereford. Mr. Hignett, who is a Director of the Company, was responsible for technical (metallurgical) control and development in all Wiggin plants. He was previously superintendent of the Mond Nickel Company's Birmingham research laboratory.

MR. R. V. ELY has been appointed Group Research Director by Lancashire Dynamo Holdings Ltd., and will, as a consequence, relinquish his position as Managing Director of Foster Transformers Ltd., and Foster Electrical Supplies Ltd. He will, however, remain on the Boards of both of these Companies with special responsibilities. MR. M. H. HAMMILL, Director and General Manager of Foster Transformers Ltd., will be in executive charge of the Company, and MR. L. D. GUNNELL, at present Sales Director of Foster Electrical Supplies Ltd., will act in a similar capacity in that Company.

MR. JIM RUST, of the North Thames Gas Board, who is Chief Inspector of Barking Life Saving Club and Chairman of Beckton Swimming Club, has been awarded the recognition badge of the Royal Life Saving Society.

MR. J. B. ARCHER, Production Manager, is retiring after 49 years' service with Ashmore, Benson Pease & Co., Ltd., gas plant manufacturers, Stockton-on-Tees.

ALDERMAN G. E. HODGKINSON, O.B.E., of Coventry, has been reappointed by the Minister of Fuel and Power to be a part-time member of the West Midlands Gas Board.

Obituary

MR. WILLIAM REGINALD GILL, of Smith Meters, Ltd., died at his home at Aberford on July 11, after a short illness. Mr. Gill had represented the Company as Northern Area Manager for more than 20 years.

Diary

July 23.—WEST MIDLANDS G.C.C.—Birmingham Education Department, Council House, Margaret Street, Birmingham. 3 p.m.

July 25-27.—ROYAL WELSH SHOW, Rhyl (Gas Council Stand No. 136).

In Parliament

AS with all other legislation before it. the Clean Air Bill toils wearily through the sort of pupal state that lies between a bill's third reading in the Commons and its emergence, like the moth from the cocoon, as the finished product. Recently the Commons have been approving Lords' amendments to the Bill.

Just as well, too, for the Upper House had spotted one or two nasty little loopholes in its provisions.

For example, but for an amendment to the clause requiring that new furnaces should be smokeless, anyone with a boiler fitted with a furnace installed on land outside a building could have belched forth black smoke to his heart's content with complete impunity.

* * *

Talking of smoke, nobody seems to know exactly what it is beyond the fact that it's what the Clean Air Bill is designed to prevent.

For, during the report stage of the Bill in the Lords, the Earl of Munster said: 'Much consideration has been given to the question of the definition of "Smoke" since the Bill was first published, and advice was freely offered by many organizations, including the Federation of British Industries. On close examination, however, each definition was found to be impracticable, due to legal complications.'

And there the matter seems to rest: It had been decided 'that no comprehensive definition of smoke would assist the objects of the Bill,' he concluded.

Sneaking back into the Commons for a moment, we find them approving another little amendment restraining owners of out-door furnaces from filling the air with grit and dust. Good show—and congratulations to all concerned for apparently knowing what grit and dust are.

Another amendment eliminates the likelihood of a never-ending succession of international maritime legal battles. As things stood, a Portuguese man of war smoking in the Indian Ocean might properly have been prosecuted. Seafaring law-breakers have been satisfactorily restricted in number by the insertion in the relative clause of the Bill of the words, 'within the seaward limits of the territorial waters of the United Kingdom.'

On the other hand, within the seaward limits of the territorial waters of the United Kingdom or ashore, a man will be allowed to smoke like a volcano provided he is doing it as an experiment. For another amendment makes it legal for a man to smoke experimentally so long as local authority is satisfied that it is expedient—in the interests of investigating pollution of the air—to let him do so.

We were interested to learn that the Minister of Health is shortly to introduce a scheme of training for hospital stokers to ensure more efficient stoking.

We feel less indulgently disposed toward the Minister of Fuel and Power who apparently does not think there's much point in urging gas and electricity boards to sell fire guards.

The boards have fire guards in use in their showrooms and their staffs are instructed to draw attention to them, and that, the Minister seems to feel, is quite sufficient.

Despite the fact that only four days previously reference had been made in the House to the 'distressing number of children still burned by unguarded fires.'

Poor show, Mr. Jones. It seems that the major hope in this direction lies in individual displays of initiative such as the recent resolution by the South Western Gas Consultative Council to approach its Board on the subject.

TRIUMPH AT LAST

After appearing in the quarter-finals in 1954, and the semi-finals in 1955, the chess team from North Thames Gas Board has finally triumphed in the national chess tournament for works teams organised by the 'Daily Herald.' Here R. J. Prince (left), Captain (Coke Department, Kensington), and T. Bispham, Chairman (Nine Elms Works), are seen with the cup.

E.M.G.B. Produce All-Time Record Output of gas

OUTPUT of the East Midlands Gas Board in the year ended March 31 last, was an all-time record of 63,755 mill. cu.ft., an increase of 1.6% over the previous year, and 24% over 1949-50. Gas sales to all consumers totalled 285,382,000 therms, nearly 7 mill. therms more than the previous year. Sales to industry and to commercial users both increased but sales for public lighting and to domestic consumers decreased.

This information is contained in the Board's report on organization and development given recently by Mr. R. S. Johnson, Chairman, to the East Midlands Gas Consultative Council in Nottingham.

'On the Right Side'

Mr. Johnson said that financially the Board was 'just on the right side.'

Coke oven gas purchased had increased from some 29,000 mill. cu.ft. to about 32,799 mill. cu.ft., making possible a reduction in the manufacture of carburetted water gas.

Despite a small reduction in the quantity of coal carbonized, the quantity of coke produced for sale had increased by 41,326 tons to 690,445 tons.

For the first time in many years coal supplies had fully met requirements.

Additional Capacity

In view of difficulties experienced last winter at Sheffield, the Board had decided to provide additional gas-making capacity by the installation of catalytic oil gasification plant at the Meadow Hall works. This should be available towards the end of next year with a capacity of 10 mill. cu.ft. per day.

The year had not been quite such a happy one for the sale of appliances, which had fallen by 25%, owing to increases in purchase tax, and hire-purchase restrictions.

During the year 406 miles of mains had been laid, and 28,951 new services connected, the North Lincolnshire grid would be completed this year, 80% of it now being in operation.

£4.5 MILL. COKE OVEN ORDER FOR SIMON-CARVES

SIMON-CARVES have received contracts amounting to about £4.5 mill. from the Steel Company of Wales for new coke oven construction in connection with the recently-announced £48 mill. development programme at the Margam steelworks.

Under these contracts two existing batteries of 90 coke ovens will each be extended by the addition of 25 new ovens, and a complete new battery of 80 ovens, together with by-product plant and coal and coke handling equipment, will be built on a new adjacent site.

When the new construction is finished there will be a total of 310 post-war coke ovens, all of them built by Simon-Carves, at the Margam works.

BRITISH AND GERMAN FIRMS AMALGAMATE

A RECONSTITUTED company, styled Drake - Didier - Kogag, Ltd., has been established, and will be supported by the interests of the well known and old established firm of Drakes, Ltd., of Halifax, and the large German interest known as Didier-Werke, trading in the most modern type of coke oven and by-product equipment, industrial furnaces, coal and coke handling and blending plants, crematoria, hot blast stoves and all systems allied to coal carbonization, gas preparation and purification.

Colonial Contracts

The Board of Directors comprises names well known in both the British and German gas and coking industry—John A. Drake, Francis D. Drake, E. Maurice Drake, E. Bieneck, A. Flockenhaus, Dr. A. Steding with Dr. F. P. Jaques as an Alternate Director. The Managing Directorship will continue to be held by Mr. Gwynne Cellan-Jones, who held a similar position prior to the amalgamation.

At the moment the company is employed on by-product contracts for colonial requirements and also for British steelworks.

ENGINEERS' PENSION SCHEME

A SCHEME to provide continuous pension cover for a professional engineer throughout his career, whatever changes of employment take place, is to be launched in the autumn by the Engineers' Guild.

The Engineers' Guild said: 'Long before the concessions were announced in the April Budget, the Guild had been preparing a scheme of group insurance for pensions, suitable for and advantageous to professional engineers, whether self-employed or not.

'Following the Budget it has been necessary to delay launching this scheme for a short period to ensure that full advantage is taken of the proposals made by the Chancellor of the Exchequer.

Advised to Wait

'Professional engineers are advised to await the launching of this scheme, which will contain special benefits for them, before deciding upon any of the new policies that are beginning to emerge as a result of the Budget proposals.

'The scheme will be open to all members of the Guild and to other members of the Institutions of Civil, of Mechanical, and of Electrical Engineers, who are eligible to become members of the Guild.'

Mr. K. C. Mead (third from left), Station Engineer at Fulham, is seen with the Fulham first-aid team after they had completed a hat-trick by winning the N.T.G.B. first-aid competition for the third year running. They are, left to right, Mr. R. McDaniel (class leader), Mr. H. Eatenton, Mr. S. Jones (captain), Mr. E. Stephens, and Mr. C. Paremain (reserve).

Output of the North Western Gas Board in June was 32,605,000 therms of gas, an increase of 2% on the supply in June, 1955. In the 13 weeks ended July 1, output was 91,283,000 therms, against 91,131,000 in the corresponding period of 1955.

Midland Section Hold Summer Meeting

INTERESTING AND SUCCESSFUL VISIT TO LEICESTER

MR. AND MRS. JOHN CORRIGAN must have been as gratified by the large attendance of Midland Section members and their ladies, at the summer meeting in Leicester, as were the visitors by the arrangements made for their comfort and entertainment.

These included an inspection of the Belgrave Gate depot and alternative visits to the Millstone Lane offices and the Sileby grid station; and in the afternoon the men went round the British United Shoe Machinery works while the ladies saw how the Bentley Engineering Company make hosiery machines and the nylons which are produced for test purposes. (An article on the Leicester Division appears on p. 157.)

Chief Guests

The Lord Mayor of Leicester (Ald. A. Halkyard, C.B., M.C., T.D., D.L., LL.B.) and the Lady Mayoress were the chief guests at a luncheon given jointly by the East and West Midlands Gas Boards, the Chairman of each of which, Mr. R. S. Johnson, M.B.E., T.D., and Mr. G. le B. Diamond, C.B.E., was present. This was at the Grand Hotel.

Mr. R. S. Johnson, proposing the toast of the guests, said it was the custom, which he hoped would long continue, for the Midland Section to hold the summer meeting alternately in East and West.

He took the opportunity of saying in public how delighted he had been by the kind and generous reception which had been given to him as the new Chairman of the East Midlands Gas Board.

Work Greatly Valued

It was obvious that both Boards greatly valued the work of the Midland Section which comprised both gas engineers and manager and provided a valuable forum where technical and managerial experience could be exchanged and studied to the advantage of the individuals and of the industry. It was excellent work and deserved the fullest possible support.

It was a great privilege to welcome as their principal guest the Lord Mayor of Leicester. He understood that in the past Ald. Halkyard was a member of the Gas Committee in Leicester and he had since shown his interest by setting aside time for the Happy Homes Exhibition.

He cordially welcomed the ladies; also Mr. G. E. Currier and other distinguished members of the industry who had come to support them.

The Lord Mayor expressed the pleasure which it gave him to renew his acquaintanceship with the gas industry. He congratulated Mr. Johnson on the position he had recently attained and Mr. Corrigan on the important office he held.

He appreciated that such meetings greatly stimulated the considerable service which the gas industry rendered to the community. In the past he had made a great many friends in the industry and he was happy to have them still.

They had had good engineers and managers in Leicester; all who had been associated with the industry in the city had done all they could to encourage its fullest possible development.

Mr. G. E. Currier, O.B.E. (Past President, now Hon. Secretary of the Institution, and Deputy Chairman, North Eastern Gas Board), proposed the toast of the Midland Section, and conveyed the greetings of the President of the Institution.

The Midlands was always regarded as a most important section of the Institution; there was no need for him to remind them of the many prominent men from the area who had been supplied from the Midlands and had done excellent service both for the industry as a whole and for the Institution.

Not the First Time

It had been said that the gas industry was at the cross roads. That was probably true, but the industry had been in that position before and it had generally found the way to prosperity. He did not think they would be unsuccessful this time.

He spoke of the extensive research and other work that was being done and said that the results were most encouraging. Of course it would be better still if they were to find natural gas, but they were rapidly approaching the day when they would know to what extent it existed under the Wolds of Yorkshire.

They were also encouraged by the Clean Air Act, though clean air was not new to the industry. He commended Birmingham for what was being done in the establishment of smokeless zones.

Coupling the name of Mr. Corrigan with the toast, he spoke of the services which he had rendered to the industry.

Mr. John Corrigan said he was very proud to be their Chairman. The Section owed allegiance to none in their support of the Institution.

He wanted to say very sincerely how much they appreciated the hospitality of the East and West Midlands Gas Boards and how grateful they were to Mr. Johnson and to Mr. Diamond for the interest and encouragement which they personally and other members of the boards took in the Section.

He was sure that encouragement would be amply repaid, that they were all better for mixing together and that through these means much greater zest and interest were applied to their work.

DUST PROBLEM HAS BEEN SOLVED AT KEYHAM WORKS

FOLLOWING complaints which he made regarding smoke and grit from Keyham gasworks, Mr. F. R. Jury, a Plymouth City Councillor, has received a reply from the South Western Gas Board reading:—

'We feel sure that we have found a reasonable solution to the dust problem, which followed the installation of a much more efficient charging machine in the retort house. Experiments both here and in other districts have been carried out with great care, and have cost considerable sums of money.

'We have placed an order for the necessary equipment, which we hope will be installed in about three months; and while we feel it is almost impossible completely to eliminate smoke and dust emerging from the type of retort house at Keyham, we do feel sure that conditions after that will be better than they were a few years ago, before the said charging machine began to operate.'

The second meeting of the Parkinson Stove Co., Ltd., Golfing Society, 'The Pagans,' was held at Harborne Golf Club recently. Mr. R. J. Rogers, President, presented a silver cup to the winner, Mr. Lewis Fletcher, and also a replica to the 1955 winner, Mr. K. F. Hollingsworth. The runners up were Mr. E. J. Ducker and Mr. A. Sadler.

The building housing the compressors and volumetric governor at Sileby and also accommodating stores and a fitters' workshop.

LEICESTER

THE many visitors to Leicester on what was popularly called Corrigan's Day (Mr. John Corrigan is Chairman of the Midland Section of the Institution and Sales and Service Manager of the Leicester and Northants Division of the East Midlands Gas Board) had spread out for them a very comprehensive view of what has been achieved in integration and development of gas supply to a mixed urban and rural area under the command of Mr. H. B. Taylor, Divisional General Manager.

Job voucher control office, Millstone Lane.

There are now, in fact, only two major and one small manufacturing stations within the Division. Aylestone Road, Leicester, is tied in with the 24 in. backbone main from Derby, which runs south-eastward through the Leicester Division. Northampton looks after its own southerly group at present; while Lutterworth still flies the flag of 30 mill. odd from its horizontal house.

From the mass of information made available to us on July 6, we have chosen for emphasis the modern methods at head office, Millstone Lane, and the transformation of the little works site at Sileby, which three years ago was supplying its own 1,300 consumers.

A30 Radio Van, Millstone Lane.

Adjoining the showrooms at Millstone Lane is the sales and service control office from which the Leicester district representative organization operates. The area of supply is divided into four districts and for each district there is accommodated in the control office one senior district representative, three district representatives, one control clerk and assistant, and one fittings foreman.

Each team is responsible for between 25,000 and 30,000 consumers and employs 15 to 20 fitters, maintenance men, and apprentices on routine work, in addition to a fitter/driver with van for changing meters, a fitter/driver with radio equipped van for escapes and emergencies, as well as a fitter/driver and an assistant service layer.

The control clerk and assistant are permanently sited here, each district being equipped with two G.P.O. and one internal telephone and one radio call receiver. Incoming and outgoing G.P.O. and radio calls are routed by the operators at the main switchboard to and from the appropriate district clerks. Internal 'phones are provided between the control office and the fitters' depot.

The district fitting foremen are based on the fitters' assembly depot, Belgrave works, one mile away. After issuing work to fitters (previously planned by control clerk) the foremen supervise district work and attend the control ffice daily for consultation with their clerks. Conversely a senior district representative on rota attends the fitters' depot at 8 a.m. each morning for supervisory duties.

Information Extracted

All job vouchers and documents are routed to the control office, sorted and re-routed to district desks by two reception and despatch clerks, who also extract statistical information for management control and undertake sundry typing duties.

The control office is under the supervision of the Assistant Sales and Service Manager and, for liaison purposes, the following officers are accommodated in the same office: Showroom Manager (control office adjacent to showrooms), new buildings and architects advisory officer, films and demonstrations officer, and authorized dealers' liaison officer.

Transfers of job vouchers and documents for delivery of stores from Aylestone Road works and for issue to fitters at Belgrave works, are made by a messenger service.

Hollerith Room, Millstone Lane.

One large room accommodates the divisional planning and clerical distribution staff and the practical distribution staff controlling distribution work in Leicestershire and Rutland. The Divisional Distribution Engineer has a private office leading off from the main office.

The practical section, in charge of the Mains Superintendent, is responsible for the mains and services supplying 136,000 consumers. Control is exercised by an assistant to the Mains Superintendent, who acts as liaison officer between the sales and service section, works departments and the distribution section. Use is made of wall maps and the radio telephone system in the planning and control of major distribution jobs, together with the day to day routing of transport and positioning of gangs.

Work now being carried out in the Hollerith department includes stores and wages analyses by cost codes; modified wages analysis by cost codes for district maintenance workers; purchases routine and production of analysis of purchases for month to supplier and cost code; and payroll routine covering payrolls to actual payslips for 1,500 employees.

To be Extended

The machines at present installed in the department, the scope of which is to be much extended, consist of four Type 31 Keystor punches, four Type 129 programme board verifiers, one sorter, one Senior rolling total tabulator, one Serial 202 reproducer, one Type 542 electronic multiplier and Type 238 gang punch, one collater, and one Lancashire Dynamo & Crypto rectifier.

The whole of the filing for the divisional office and the Leicester undertaking is done in a central registry, using the lateral filing system. The registry is divided into two sections—in one is filed all correspondence of a general nature, whilst the other section relates solely to consumer service, and aims at having a separate file for every property, thereby building up a history of gas fittings work undertaken and of visits by home service advisers.

An extra copy of the job voucher is taken and filed, thus eliminating the necessity to transfer information from one document to another. Home service advisers make use of the foreman's copy of the voucher for a follow-up visit upon completion of the job.

A drawing office service is provided for both works and distribution departments throughout the Division.

The office has been mainly concerned during the past two years with the divisional grid main scheme, and has prepared all the route maps, designed the special crossings and buildings, and detailed all plant associated with grid reception and recompression stations.

The Belgrave Gate and Sileby stations included in the itinerary have been designed and 'engineered' from this office, which work has entailed not only the preparation of drawings, specifications, etc., but also in many cases site supervision.

Allied to the drawing office is a photo printing section, equipped with reflex, auto-positive and dyeline photo printing machine, which enable reproduction of any type of drawing or document to be made.

Sileby Gasworks

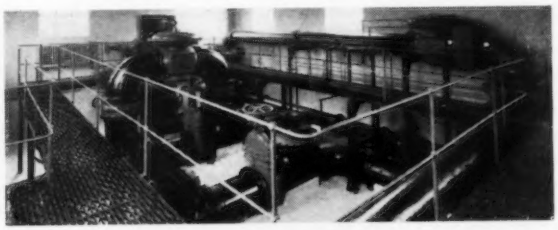
The Sileby works ceased manufacture on July 25, 1953. The plant consisted of horizontal retorts and traditional wet and dry purification plant which has all been demolished. One gasholder having a capacity of 100,000 cu.ft. is now the only principal item of plant remaining.

There are 1,353 consumers in Sileby and the total sales amount to approximately 34.5 mill. cu.ft. per year, equivalent to 165,000 therms. The gas is fed into the station from the 24 in. backbone main by means of an 8 in. diameter leg 4 miles long.

Local gas reception and distribution equipment comprise a 6 in. volumetric governor, 6 in. by 18 in. Connersville type station meter, a gasholder, a fan type booster and a diaphragm type station governor.

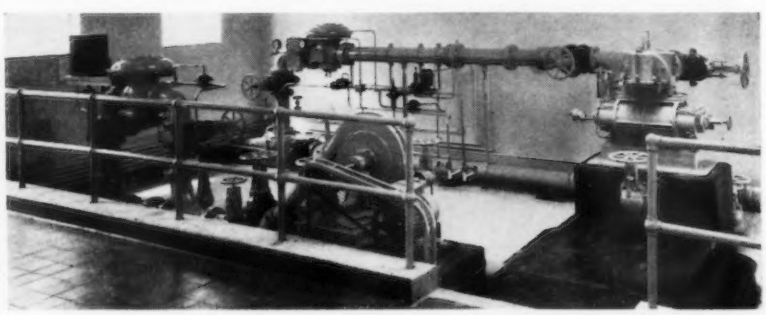
In order to recompress the gas for Melton Mowbray, Oakham, and Uppingham which are supplied through this station from the same leg as that from which Sileby is fed, duplicate sets of Donkin compressors are installed—one to act as standby to the other. The lengths of main from Sileby served by this compressor comprise 21½ miles of 6 in. main for the Melton Mowbray and Oakham feed and 7 miles of 4 in. main from Oakham to Uppingham.

The compressors pump gas direct through the 8 in. incoming main and deliver it into the 6 in. main passing forward to the three towns. Normally the inlet pressure to these machines varies between 5-10 p.s.i. and the outlet pressure between 10-20 p.s.i. The machines are designed for an eventual load which may require 30 p.s.i. The compressors are electric motor driven by 70/35 h.p. slip ring motors, having change pole features for 1,460/730 r.p.m., the starters for which are equipped with constantly rated rotor resistances to enable a 20% speed variation to be applied to either of these two speeds. The motors are segregated from the compressors by gas type glands in wall boxes.



Grid reception plant, Sileby.

The compressors are equipped with individual after coolers and individual diaphragm type relief valves in addition to various electrical safety equipment. These diaphragm type relief valves provide protection against excessive outlet



Volumetric governor, Sileby.

pressure; protection against low inlet pressure; and starting up and shutting down protection by means of pilot magnetic valves so that the machines get away and shut down *without* load, i.e., due to the reservoir of gas pressure in the outlet main. In this way the risks of a strained crank shaft are avoided.

Cooling water for the compressor jackets and the after coolers is provided by means of duplicate Worthington-Simpson pumps drawing and delivering their water from and to a large overhead tank.

The electric motors have in their starter circuit a pressure switch to stop the compressors when the outlet pressure exceeds that to which it is pre-set, and shut down the motors in the event of the water temperatures rising above that to which they are pre-set, thereby protecting the compressors against a failure of the water circulating pumps. The whole installation is fully automatic and is designed to run without attention.

The mechanical lubricators are of large capacity and are replenished by the local District Superintendent, major overhauls being carried out by staff drafted in from Leicester. A log is kept on the site showing the running time of the machines and the key temperatures in the cooling water circuit, the electricity consumption and other principal statistics.

The building accommodating these compressors and the volumetric governor equipment for the local town supply was at one time a coal store. The roof and the back wall are original, but the front wall is new. Adjacent to the compressor house and as part of this same original coal store is a consumer service imprest fittings store and fitters' shop.

I.G.E. MANCHESTER SECTION VISIT COKE OVENS

BEFORE the Manchester and District Section of the Institution of Gas Engineers visited the Hemsworth and United Kingdom Coke Oven Co., Ltd., at Pontefract, they were entertained to lunch in Pontefract Town Hall by the Chairman and Members of the North Eastern Gas Board.

Dr. R. S. Edwards, Chairman of the N.E.G.B., and of the Hemsworth and United Kingdom Coke Oven Co., Ltd., proposing the toast of the Borough of Pontefract and Guests, said that the coke oven plant at Hemsworth was an excellent example of co-operation between nationalised industries. The National Coal Board owned 60% and the Gas Board 40%.

Among the guests were Sir Henry Jones, M.B.E., President, I.G.E., Col. W. M. Carr, Mr. R. C. Wardell, Chairman, Eastern Section, I.G.E., the Town Clerk, Borough Treasurer, Chief of Police and Deputy Mayor of the Borough of Pontefract.

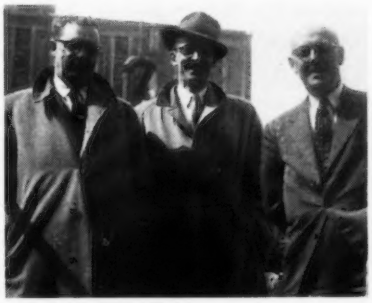
History Outlined

Councillor R. Egan, Deputy Mayor, who said that it was pleasant to have meetings of this nature in the town, sketched an outline of the town's history and its present-day status.

The toast of the Manchester and District Section, I.G.E., was proposed by Sir Henry Jones. He stated that this meeting was the first official function in his year as President of the Institution and he was particularly pleased to be present.

Mr. J. M. McLusky, Chairman, Manchester and District Section, replied. He said that there was no doubt of the part the Section had played in the affairs of the gas industry. He was very pleased to see 12 past Chairmen supporting him and he thanked the Chairman and Members of the North Eastern and North Western Gas Boards for their encouragement and entertainment.

Left to right: Sir Henry Jones, Mr. H. S. Illingworth, Mr. J. M. McLusky, Dr. R. S. Edwards, Col. W. M. Carr, Mr. A. McDonald, and Mr. Johnston.



Left to right: Mr. N. C. Sturrock, Mr. N. Hudson, and Mr. L. Roberts.

Left to right: Mr. A. McDonald, Mr. N. G. Appleyard, and Ald. Sutcliffe.

FORMER GAS BOARD COUNTER CLERK JAILED FOR THEFT

JAMES ALEXANDER GRAHAM (29), of Falkirk, formerly a cashier counter clerk with the Scottish Gas Board at £550 a year, was sent to prison for six months at Falkirk when he admitted having embezzled £216 7s. 7d.

A solicitor said Graham's wife was expecting their first child at the beginning of next month. The money had not been used for drinking or gambling, but had gone for household purposes. An offer had been made to repay the money in full, but the Gas Board had refused it. They retained £151 13s. 8d. due to him.

Graham had taken a small amount of money, which he 'paid back' by taking more, and the matter had snowballed until it was out of his control.

Swadlincote U.D.C. are to consider the possibility of providing gas or electricity cookers only, in houses built in the future. A recent survey showed that they were preferred to combination cooking ranges installed in the past.

Output of Gas at the Lambton coke-works of the Durham Divisional Coal Board was recently reduced by about 2.5 mill. cu.ft. a day owing to 'go slow' working by employees in support of claims for higher wages.

Presented to the Manchester District Junior Association of Gas Engineers, March 17, 1956.

The C.A.L. Plant and Effluent Disposal System at Stockport

By J. K. LORD, M.Inst.Gas E., A.M.I.Chem.E., A.M.Inst.F.,

STATION ENGINEER, STOCKPORT UNDERTAKING, NORTH CHESHIRE GROUP, NORTH WESTERN GAS BOARD.

As the result of a Court of Enquiry held in April, 1953, by the Ministry of Housing and Local Govenment, consent was received from the Ministry to dispose of ammonia effluent under certain conditions in the River Goyt, and we were now in a position to give full consideration to designing a system that would enable us at all times to meet these conditions, and one which would do so with a minimum of supervision and apprehension and a maximum of economy and efficiency. Under no circumstances was the ammonia in the effluent to exceed 600 parts per million, or the oxygen absorption factor to exceed 12,000 parts per million. The flows of effluent were rigidly specified according to the season and the period of the day. The whole document was known as the trade effluent notice.

The coal gas plant at Portwood Works, Stockport,, consists of Woodall-Duckham continuous vertical retorts with a total nominal throughput of 570 tons per day, equivalent to 208,000 tons per annum.

Achieved in Practice

When allowance is made for scurfing, repairs and re-setting of retorts, it is found that the maximum amount of coal likely to be carbonized is 160,000 tons per annum, and this figure has been very nearly achieved in practice.

The figure of 160,000 tons per annum will therefore be taken as a basis for calculation, and it is useful to split this between the periods May-September (inclusive) and October-April (inclusive) to correspond with the varying conditions of our trade effluent notice.

Coal carbonized May-Sept. (inclusive) ... ... 54,000 tons
" " Oct.-April (inclusive) ... ... 106,000 tons

Under normal circumstances, the vertical retorts are operated at rated throughputs to give an 'ex retort house' C.V. of 470 B.Th.U. per cu.ft. and with added air for purification and after benzole extraction the final C.V. is reduced to the declared value of 450 B.Th.U. per cu.ft.

Crude Liquor Production

All tar and liquor produced eventually flows to the tar and liquor separator. After re-circulation of retort house liquor and other steps to minimize the final volume of liquor made have been taken, the yield of liquor of average strength is 1.35% w/w. A free ammonia after separation works out at 45 gal. per ton of coal carbonized.

The crude liquor production therefore will be:

		Gal.	Av. Gal. per hr.
5 months	May/Sept. (inclusive)	$54{,}000 \times 45 = 2{,}430{,}000$	662
7 "	Oct./April (inclusive)	$106{,}000 \times 45 = 4{,}770{,}000$	938
		7,200,000	

The trade effluent conditions allow a maximum discharge of:—

		Gal.	Days.
5 months	May/Sept. (inclusive)	$19{,}200 \times 153 = 2{,}937{,}600$	800
7 months	Oct./April (inclusive)	$24{,}000 \times 212 = 5{,}088{,}000$	1,000
		8,025,600	

These figures show that in the summer months, the ratio of effluent *permitted* to crude treated would be $\frac{800}{662}$ or 1.21:1 and in the winter months $\frac{938}{1{,}000} = 1.07:1$.

As will be seen from the plant details which follow, the ratio of effluent *produced* to crude treated is 1.14:1. It is obvious, therefore, that assuming these maximum conditions, we should be producing more effluent in the winter than is permitted by the Minister's consent, so that in summer effluent produced $2{,}430{,}000 \times 1.14 = 2{,}770{,}200$ gal.—a deficit of 167,400 on the maximum permitted, and in winter effluent produced $4{,}770{,}000 \times 1.14 = 5{,}437{,}800$ gal.—a surplus of 349,800 gal. over the maximum permitted, and an overall annual surplus of $349{,}800 - 167{,}400 = 172{,}400$ gal. will be the result.

The situation, however, is not so serious as would appear, as provision is made in the new plant for returning specially cooled effluent to the static washers as washing medium.

Two Main Points

Two main points emerge from the above figures. First, it is obvious that we must not lose any opportunity of disposing of effluent at the maximum permitted rate, even if the C.A.L. plant should be shut down for repairs or the like, and we must continue to discharge effluent at, or near to, the prescribed rate. It is necessary, therefore, that we should hold a reasonable volume of effluent liquor in store against such an eventuality, and similarly that we should have storage accommodation for temporary production of effluent in excess of the permitted discharge rate. It may also be necessary to hold over some of the winter make for discharge in the summer, and it will certainly be necessary to hold back some of the night make for discharge during the day. Secondly, should the C.A.L. plant be shut down, we must be able to store the crude liquor made during this period, or during any period when the production of crude liquor is in excess of the throughput of the plant.

Additional Storage Capacity

The underground liquor well of 125,000 gal and the overhead feed tank of 25,000 gal. gave a total storage of 150,000 gal., which is equivalent to $\frac{150{,}000}{540 \times 45}$ or 6.2 max. days make of crude liquor. We would therefore only be able to accommodate this 6.2 days' make if the storage tanks were empty to start with. It was therefore decided to add 200,000 gal. to the storage capacity for crude liquor. This would increase the total crude storage capacity to 350,000 gal., equivalent to 14.4 maximum days make of crude liquor.

Effluent liquor storage we did not possess at all, and it was imperative that we must also be able to accommodate any possible over-production of effluent during the winter, or any other temporary over-production which might be necessary from time to time. It was therefore decided that in order to give ourselves the necessary flexibility we ought to have storage for effluent rather in excess of that for crude liquor (ratio 1.14:1), i.e., approximately 400,000 gal.

16

OIL GASIFICATION PLANTS
(HALL PROCESS OF AMERICAN GAS ASSOCIATION)
now in operation* or under construction†

		Number of Sets	Millions cu. ft./day
TWO SHELL SETS	† ALFORTVILLE, FRANCE	1	6·5
	* BROCKTON, MASS.	1	5
	* CAMBRIDGE, MASS.	2	13
	† **GLOUCESTER, ENGLAND**	**1**	**1·5**
	* LOWELL, MASS.	1	5
	* LYNN, MASS.	1	6
	* LYNN, MASS.	2	9
	* NEW BEDFORD, MASS.	1	5
FOUR SHELL SETS	* BALTIMORE, MARYLAND	1	5·5
	* CAMBRIDGE, MASS.	1	5
	* FRAMINGHAM, MASS.	1	5·5
	* GENNEVILLIERS, FRANCE	1	2·5
	* MANILA, PHILIPPINE ISLANDS	2	3
	* NEW BEDFORD, MASS.	1	6·5
	* NEWPORT, RHODE ISLAND	1	3
	* WORCESTER, MASS.	1	5·5

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Three cast iron above-ground tanks, each of 200,000 gal. capacity, to be manufactured and erected by R. & J. Dempster Ltd. of Manchester, were ordered. These tanks, each 50 ft. in diameter and 16 ft. high, with timber roofs, have been constructed on reinforced concrete plinths on West's piling foundations, and are situated some 300 yards distant from the C.A.L. plant, with inter-connecting pipework in 4 in. dia. C.I. main with screwed gland joints.

As the emphasis is on continuous operation of the liquor concentration plant, it is equally important that storage for the concentrated liquor made should be provided. Removal of concentrated liquor from the works is by road tanks, and bad weather conditions and the inability of the chemical works to receive liquor for a period might cause delays. It was thought that a storage capacity equivalent to approximately 14 days maximum production would give us adequate safeguards.

The concentrated liquor storage consists of four horizontal cylindrical mild steel tanks, each of 8,000 gal. capacity, fitted with ring-packed vent scrubbers through which raw weak liquor is circulated and returned to the plant liquor feed tank via a scrubber-liquor rack cooler (if required).

The make can be directed into any tank and can be withdrawn from any tank by means of a loading pump which will deliver either to the loading arm or, if required, to the overhead raw liquor storage tank if re-circulation is desired.

Flow of Liquor to Concentrated Liquor Plant

Tar and liquor from retort house separating tanks, foul mains, condensers, Livesey washers, tar precipitators and ammonia washers pass to a small tar and liquor receiving tank (or separator) from which the tar gravitates to the tar well, and liquor overflows to the underground liquor storage well (capacity 125,000 gal.).

From the underground liquor well, crude liquor is pumped to an overhead crude liquor tank (capacity 25,000 gal.). The volume of liquor pumped to this tank is in excess of the maximum C.A.L. plant throughput, and so there is a continuous overflow of liquor which returns to the separator. This overflow is from the base of the overhead tank, and any tar vesicles which settle are more likely to return with the overflow. A bottom run-off from the overhead tank also returns to the separator.

A small continuous sample of liquor from the outlet side of the pump is passed through a sight glass on its way back to the liquor well. This sight glass unit incorporates a light-source and an 'Elcontrol' photo electric cell which tests the clarity of the liquor. Should it fall below a pre-determined value, the photo-cell causes a valve to open and allows the liquor to return to the separator instead of going to the overhead tank. When the liquor becomes clear again, the photo-cell mechanism closes the valve and permits the liquor to proceed to the overhead tank. The sensitivity of this mechanism is adjustable, and the equipment operates an alarm whenever liquor is being rejected. These precautions ensure that the overhead tank is always full of clean crude liquor ready for feeding to the concentration plant.

Although our maximum production rate of crude liquor is less than 1,000 gal. per hour, it is sometimes necessary to exceed this rate of feed to the concentration plant in order to 'catch up with' the effluent position or to reduce our stock of crude liquor. The new concentration plant therefore must be capable of dealing with 1,200 gal. per hour of crude liquor, producing a concentrate containing 18% to 20% w/w of free ammonia, and an effluent of not more than 300 parts per mill. (0.03%) of free ammonia, at a temperature not exceeding 90°F., and a proportion of which (up to a maximum of 300 gal./hour) must be cooled to within 10°F. of the temperature of the cooling water available.

As continuity of operation has been the main consideration, all the units except for the still and de-carbonator, are in duplicate.

The main raw liquor feed is preheated in the C.A.L. condenser/liquor preheater by the condensation of the product vapours, and the warm liquor leaving this heat exchanger is fed to the reflux condenser/liquor preheater where it receives further preheat from the partial condensation of the vapours leaving the still. The hot liquor is then delivered to the top tray of the decarbonator where it is stripped with open exhaust steam and carbon dioxide dissociated therefrom to prevent crystallisation of the final product (at 0°C.). The decarbonated liquor flows by gravity to the still where it is stripped with a current of open (exhaust) steam. The spent liquor leaves the base of the still through a float valve.

The vapours leaving the decarbonator contain a certain proportion of ammonia, and in order to recover the bulk of this ammonia, the vapours pass through the decarbonator scrubber which is irrigated by a stream of cold raw liquor which gravitates to the decarbonator. The vapours leaving the scrubber pass through a safety seal and are then conducted to the works foul main.

The vapours leaving the still are partially condensed in the reflux condenser/liquor preheater, the condensate at the outlet of this heat exchanger being returned to the still, while the vapours pass on to the C.A.L. condenser/liquor perheater for final condensation, and thus become the product which is finally cooled in a rack-type cooler before passing to the storage tanks.

The still is constructed of cast iron sections which are 4 ft. 6 in. dia. There is a base section and 14 trays. Each try is fitted with two bubbler hoods having triangular serrations around the edges. The liquor descends from tray to tray by large section downtakes, and each tray is suitably baffled so that the liquor flows positively around the periphery of each bubbler hood. Low pressure steam is admitted to the base of the still through twin cracker pipes.

The decarbonator is of similar design to the still, and is mounted on top of the tube-in-tube condenser unit in order to give sufficient head for delivery in to the still by gravity flow. It is 4 ft. 6 in. in dia. and has a base and two trays.

The reflux condenser/liquor heater is of the tube-in-tube type and of cast iron construction. The liquor flows through the inner tubes and the vapours in the annulus between the tubes.

The whole unit is duplicated and connections and valves are so arranged that either unit can be used independently.

The final C.A.L. condenser/liquor preheater is of similar construction to the reflux condenser and is mounted directly below it. To promote the maximum heat transfer coefficients and make the most effective use of the area available for heat transfer, the condensing vapours pass inside the inner tubes and the liquor through the annulus between the tubes. This unit is completely duplicated and either unit can be used independently.

The C.A.L. product from the final C.A.L. condenser/liquor preheater may be finally cooled in the C.A.L. rack cooler when found necessary, as it is felt that, when feed liquor only is used as the cooling medium, there is not sufficient control over the cooling of the product. This unit is also arranged in two independent halves, each half being designed to handle 66% of the total maximum load.

The effluent cooler is of the rack type and is of cast iron construction, and irrigated with water.

Counter Current

The effluent liquor enters at the bottom of the unit and flows upwards, counter current to the water flow. The main section of the cooler is designed to cool the whole of the effluent to 90°F. with cooling water at 50°F. and a portion of this cooled liquor (up to 300 gal. per hour) is then taken off and passed through a further series of cooling tubes to reduce its temperature to within 10°F. of the cooling water temperature. The whole of this unit is duplicated to give 100% standby capacity.

The decarbonator scrubber is of cast iron construction and is mounted above the decarbonator. It is irrigated with a proportion of the liquor fed to the plant, the liquor then flowing by gravity to the decarbonator and to the still. The scrubber is 8 ft. by 2 ft. in dia. It is packed 6 ft. deep with 1 in. by 1 in. Raschig rings.

The product leaving the C.A.L./liquor preheater flows to the rack cooler, and at this point the vapours are vented to the product scrubber which is irrigated with raw liquor. This liquor is returned to the raw liquor feed tank after cooling in the scrubber liquor rack cooler. The product scrubber is 8 ft. high by 1 ft. 6 in. dia. and is packed with 5 ft. of 1 in. by 1 in. Raschig rings.

The C.A.L. tank scrubbers, one to each C.A.L. storage tank, are 4 ft. by 9 in. dia., and are packed with 3 ft. of 1 in. by 1 in. Raschig rings.

The liquor used as an irrigating medium on the C.A.L. tank

vent scrubbers and product scrubber is returned to the crude liquor working tank via a rack cooler incorporated in the main product rack cooler unit.

A cast iron foul gas seal pot is provided on the combined vent gas line from the scrubbers and is designed to give a seal of 8 in. W.G. to exclude the possibility of drawing air to the exhauster inlet main.

The spent liquor leaves the base of the still through the float control valve and flows by gravity to two (in series) cast iron settling tanks, which are fitted with baffles and suitably arranged overflows between compartments so that, if all the precautions already taken to eliminate tar from the feed liquor should fail, tar vesicles may be separated from the spent liquor in these tanks. If necessary the tanks can be converted readily into coke filters.

The spent liquor must be discharged into the sewers at four different maximum rates, as follows:—

Summer (night time) 480 g.p.h. *Summer* (day time) 960 g.p.h.
Winter (night time) 600 g.p.h. *Winter* (day time) 1,200 g.p.h.

To comply with the conditions laid down it was decided to instal an automatic system which would only require manual adjustment at the times of changing from summer to winter conditions and *vice versa*.

A Lea recorder, operated by its own float, produces a continuous record of the flow passing into the sewer.

The control of the plant is effected through a cubicle panel, mounting all the instrumentation and automatic control stations. In several respects the panel is unique in the gas industry and incorporates recent advances in the technique of continuous process control. Of these, the stack-type force-balance controllers and the graphic panel representation of the process will be of particular interest. The system is pneumatically controlled throughout.

Working Results

At the time of writing this paper, the C.A.L. plant is being commissioned by the contractors. No full scale tests have been carried out as yet, but short-duration runs have been made at crude liquor flows of approximately 1,000 gal. per hour and 1,200 gal. per hour in order to gain information on which to base an assessment of the probable working results at these rates of flow.

A test result is shown in Fig. 1 on p. 164. An estimate of the cost of running this plant has been made, basing the calculation on a yearly throughput of 150,000 tons of coal carbonized, and not 160,000 tons, as used when calculating plant capacities. This quantity of coal seemed nearer to that achieved in practice.

The calculated cost of operating this plant worked out at 0.140d. per therm of coal gas made. The sale of the concentrated ammonia product was calculated to bring in 0.159d. per therm of coal gas made, and so to realize a profit of 0.019d. per therm.

DISCUSSION

Mr. M. Redman (Manchester), opening the discussion, said it was stated that the vent scrubber liquor link from the storage tanks passed through a rack cooler. As considerable precautions had already been taken to cool this to atmospheric temperature, why was it necessary to provide a cooler at the atmospheric scrubber?

Details had been given of the open tanks from which the liquor was fed from the bottom of the still to separate any tar or light oil distilled off. Did not Mr. Lord think that it would have been better to have used closed tanks, because the amount of steam given off from these tanks was very unpleasant and quite likely to cause corrosion of nearby structures?

In his opinion it was not very effective to fill with coke because the tar clung to the coke and then floated off. Referring to the control gear for controlling the rates of discharge to the works, he presumed this was put in to the requirements of the local authority but it seemed to him that it would have been much less costly if a simple orifice meter with a pneumatic controller had been used, it would have cost less than the Lea recorder and it was possible to get a primary controller to change over the rates of flow as required.

Mr. Redman asked whether the steam consumption was based on test results so far, or on contractors guarantee figures; from the figures he had worked out the steam consumption to be 20.5%, but the paper gave 17% during the test at full flow. Mr. Lord had taken £880 for repairs and maintenance which was rather low when spread over the whole life of the plant, say 25 years, he himself felt it was optimistic to say the plant would run at a profit. The price for C.A.L. was liable to vary and was based on the price of sulphate which had recently fallen.

The capital cost of this scheme—£60,000—was very high, but it had to be realized that this was to some extent a special case and there had been considerable resistance from the local authority concerning the discharge of effluent; when this was taken into consideration the capital charge was quite low.

Borehole water at 4d. per thousand gal. was very cheap, but not everybody had this. It was important on this plant to give attention to water consumption. Good control with cooling water could be provided from the cooling tower but the water from the rack was too weak to deal with on the coolers; it had a very low temperature and required a large tower to deal with it.

He felt that the figure of 45 gal. per ton of coal carbonized would surely be lower when the effluent was returned to the ammonia washer after washing the gas; this figure had been taken earlier on in the paper and was probably obtained at a time when the gas was being washed with water.

The figure on the balance flow sheet for steam consumption on the plant seemed to be very low, impossibly so when one considered that liquor came to the plant at a temperature of 60°F. and had to be warmed up to still outlet temperature, which was normally 105°C. If this was worked out it would mean a steam consumption of the order of 16%. Taking the 77.6 gal. of product which came solely from the steam and dividing this by the feed, 1,220, would give 16.6 and 6.4% total steam consumption of 23%; the actual figure shown on the second half of the flow sheet was 17.2% and it was clear the steam meter was in error. These figures could be confirmed in another way by taking the total volume of effluent, 1,375, and adding to this the volume of product, 77.6 = 1,452.6, and deducting from this the volume of feed, 1,220, giving 232.6% = 23.3% of steam, which was very near to the previous figure. Mr. Redman felt the figures were in error, and were misleading; possibly this was due to the short duration of the tests.

Unnecessary Refinement

Mr. Lord, in reply, referred to the cooler on the concentration tank vent scrubber link, which, he said, was a rather unnecessary refinement. It was alongside the storage tanks and it was a simple matter to incorporate an extra tube or tubes in that particular rack cooler to ensure that the liquor was cool on its return. He agreed that closed settling tanks were to be preferred and it was proposed to close them in. He agreed also that if possible coke filling would not be used; it would not be necessary, and he felt it was far more beneficial to exclude the tar from the feed liquor first rather than try to deal with it once it came out of the still. That was the reason for the precautions with the feed still unit and return from overhead tanks, to ensure that the product going to the liquor plant was good and that trouble should not be experienced with tar. There was always the possibility of light oil, which would float on the top of the tanks but this could be easily removed.

It would be a simple matter to replace the meter with a pneumatic controller, which it would have been preferable and as good, but he did not think it would have been cheaper, since the pneumatic controller would require a compressed air supply and there was no compressed air in that vicinity. The storage tanks which discharged the effluent were right away from the concentrated liquor plant and compressor which dealt with the controllers and were situated as close as possible in order to reduce the long run that would be necessary for the discharge.

Referring to the estimated steam consumption, this had been prepared before even the tests indicated on the flow sheets were carried out and were based on contractors' estimated steam consumptions.

Mr. Lord said that £880 was possibly a low figure for repairs and maintenance. It might be that Mr. Redman had taken this in conjunction with the capital cost of £60,000, and in that event he agreed it was low when one considered what parts of the plant would not require maintenance, but he did not think the figure would be far out. The cast iron storage tanks

and sewers, 300 yards of which were laid from the outlet Lea recorder installation to the sewer in Gt. Portwood should be all right for 60-70 years. The cast iron parts of the liquor plant would not require much maintenance and the corrosive parts of the liquor plant could, with modern methods of treatment and painting, be reduced to a reasonable figure. Although £880 was fairly low, it would probably be no more than this for four years of its life, and although it might increase later, Mr. Lord did not anticipate any great increase.

Referring to the capital cost being high, Mr. Lord said that £60,000 was a lot of money, but well over £20,000 had been taken up in the crude liquor and effluent storage tanks alone. The sewer from the outlet of the Lea recorder to the main sewer in Portwood had run away with a considerable amount of money, and there had been a great deal of excavating involved in laying this under the street, the excavations in some parts going to a depth of 20 ft. In addition, the plinths on which the storage tanks stood had to be specially piled on West's piling because it had been found that the ground where they stood was so riddled with old boiler flues from a previous occupier. Although the total amount of £60,000 was a high capital cost, it was not unduly so.

Borehole water at 4d. was, he thought, a fair figure; if there was no river then, of course, the cost of operating the plant would go up. But he had made a point in the paper of saying that this was the plant and system at Stockport, and he had quoted the conditions with which they had found themselves faced; others putting in a similar installation would have to make adjustments to these figures.

Low Steam Consumption

So far as the 45 gal. per ton of coal carbonized was concerned, this was the original figure stated as going to the static washers, and although the same figure had been used in this case there would be less crude liquor than was actually stated in the paper. This would make some difference to the figure but not substantially so.

The steam consumption on the flow sheets was low. Mr. Redman had indicated that it was impossibly low, but he had tried to stress this in the paper and not hide it. The flow sheets were prepared from rather scanty data, and he agreed there had been some error at the time which was not consistent now.

Mr. A. K. Howell (Manchester) asked if, in the event of failure of the compressed air and with the steam valves shut, whether the liquor flow stopped at the time. **Mr. Lord** replied that all the controllers on the liquor flow were automatic and therefore when the steam valves shut the liquor valves shut also. **Mr. Howell** further asked if there was any provision on the storage tanks for running off any phenolic oils distilled over the product, to the product storage tanks. **Mr. Lord** replied that there was.

Mr. L. G. Townsend (Liverpool) referring to the figure of 45 gal. per ton of coal carbonized, said that 1.35% was appreciably less than the generally accepted figure for continuous vertical retorts and wondered whether this was used to keep the actual volume of liquor down to the minimum. The actual recovery of ammonia appeared rather low and he wondered whether the problem was complicated by effluent from other sources, i.e., the C.W.G. plant, and whether the amount of flow passing into the sewers was approaching the 0.5% which was regarded as the maximum with which a normal sewage works could deal. He asked about the virtue of a separate dissociator from the still, saying that it was usually quite convenient to put this on the top of the still and that seemed to be a happy arrangement. It occurred to him that the still with 14 trays appeared to be too large. The efficiency of the trays was not very high and it could be shown that theoretically five were adequate for this work.

Possibly it would be felt that the instrumentation on this plant had been elaborate, but he felt that it could be justified. Referring to the steam controller on the still, it hardly seemed a point where such a complicated type of controller was necessary. A fairly steady Lea ordinary proportional controller would have covered this. In the normal way such a plant as the concentrated ammonia plant would run, say, five years without serious trouble and then the fun started. It always seemed to start in the same place—in the switchgear or heat exchanger unit—which seemed subject to serious corrosion troubles; he assumed that this was the reason for the duplication. He felt that the main reason for doing this was that the conditions in the preheater condensing unit were so variable, and maybe they had found something that would be all right. There was no doubt that this was the biggest source of trouble in the C.A.L. plant, but he did not think it could be overcome with elaborate instrumentation.

It was essential not only to have a steam meter but also to have some means of measuring the volume of effluent. This could be measured more accurately than the steam consumption, and when the steam consumption was worked out theoretically it was always ridiculously low.

Mild steel C.A.L. tanks were subject to very severe corrosion and he wondered whether they had followed any particular form of treatment to prevent corrosion on the inside of the storage tank, particularly in the vapour space. It was very difficult to apply a form of paint because of the steam distilled phenols which formed on top of the liquor.

Mr. Lord, replying, said that Mr. Townsend seemed to think the ammonia strength was low at 1.35%. Perhaps it was, and this was not entirely due to the method of operation at Stockport. As far as plant operation was concerned, they were subject to a certain amount of dilution in the liquor separator and the tar tank also. It was a little unfortunate that they had a certain amount of surface drainage in the tar well, which was below ground, and they also had certain things deposited in the tar well from the distribution department, which accumulated as liquor on top of the tar in the well; obviously they could not dispose of this. The oil mentioned did not appear to be terribly bad. Dr. Key's, in his book, had stated the results from C.V.R.'s on good Yorkshire coals, and had given the result as 1.33% free ammonia.

The fact that the flow of effluent was not more than 0.5% of the sewage capacity was very much stressed at the enquiry, the argument put forward being that the effluent from Stockport works was greater than the drainage area of the Stockport Borough Council. However, it was resolved that Stockport sewage works was capable of taking this effluent. He believed that at times it might exceed 0.5% but not by very much in dry weather conditions.

Referring to the separation of the dissociator or decarbonator from the still, he did not think it was important. In actual fact this was alongside the tower, but there was no particular virtue in this, and it was probably simpler to have a separate unit than to incorporate it in the still. The still was not large. He was particularly pleased to hear Mr. Townsend say that five plates in the still were sufficient for the job. From the original diagram, when this was first envisaged, it was worked out that rather more than five would be required, the actual plate efficiency being slightly under 50%.

Not Over-Elaborate

Anybody seeing the plant would not think the instrumentation was over-elaborate, but he felt the point was rather that the description of the instrumentation was rather elaborate. It seemed to be felt that an ordinary proportional controller from steam to still would have been adequate, and so it would, but in the circumstances it was decided that this particular type of instrument would suit the case very well. There was not much difference in price between some of these controllers and the more orthodox types.

In his reference to the C.A.L. plant running well for the first five years and then running into difficulty, Mr. Townsend was probably basing his experience on some of the wartime plants made with queer material, and heat exchangers being used and not proving satisfactory. There were several cases in which other types of cast-iron heat exchangers had lasted many years.

Finally, reference had been made to the necessity for measuring steam consumption to the plant. He fully agreed that this was necessary, that there should be a steam meter which must be accurate, and also that it was necessary to measure the volume of the effluent. They had made no special precautions for preventing corrosion in the tanks except that the tank was of a particularly thick mild steel and they were therefore expecting the life would be longer than if the tank had been made of thinner material.

Mr. H. G. Cooper (Simon Carves Ltd.) in reply to Mr. Redman's remarks on steam consumption, said the liquor was received at 90° and not 60°F. There was an error due to the fact that the steam supply was of higher pressure than that for which they were asked to design and the instruments were

slightly in error. The figures quoted were true ones from the steam flow records. In addition, it was only fair to say that the test figures were calculated and not measured, the reason being that they were short runs.

Concerning Mr. Townsend's comments on the number of trays required, there was a great deal of controversy on this, and they had assumed a K factor of 11 for the vapour gas liquor, which was a fairly good assumption to take; their research department had said it was of the order of 10.5, and Pinion, 30 years ago, got 11.6. With the effluent which would be produced he felt it would be found that 10,000 gal. per hour would require 8½ plates and 1,200 gal. 9.3 plates. Based on the estimate of 0.6% the number of plates would be reduced, but one could not put plant in marginally when people had stipulated that it must be less than 0.6%.

With regard to the method of construction, this was a very controversial matter. It had been stated that one could no more use costly metals in thin sections (which would probably last no longer and cost just as much) than thick sections in cast iron; unfortunately a choice between the two had had to be made.

He stated that the effluent disposal scheme at Stockport was typical of most places in the North West. In certain other areas it was very important that the effluent liquor was improved considerably, and he recalled one case where it was necessary to remove the phenolic constituents with a view, it seemed, to the water being used ultimately for drinking in London. It had been proved that a slight proportion of higher tar acids could be removed, and according to Dr. Blackburn this was a very useful contribution to the problem.

Mr. R. C. Greaves (St. Helens) thought that the answer to the corrosion of cast iron liquor tanks was to put in concrete liquor tanks. They had experienced a lot of trouble at St. Helens and had installed concrete tanks which they believed would be the pilot plants for the North Western area.

The reference to the electric cell unit had interested him as it was a member of the St. Helens staff who had first introduced this for keeping watch on the tar in the C.A.L. plant. Some work had been done on trying glass as a material for the condenser tubes, and while the discussion had been taking place he had wondered about the use of plastic, and whether it could be used.

Replying, **Mr. Lord** said that so far as the corrosion of tanks was concerned, the reference was to concentrated liquor storage tanks, and he did not think there would be any difficulty in the storage of effluent or crude liquor. The likeliest source of trouble was in the concentrated liquor tanks which were not of the same capacity as the effluent and crude tanks and were more easily replaced if the cast iron corroded. He was hoping that with the use of heavy gauge mild steel they would last for some time.

So far as the use of other materials for heat exchanger tubes were concerned, cast iron was not an ideal material for the heat exchanger tubes because of the heat transfer through the cast iron, but neither were some of the other materials which had been recommended, except the extremely expensive ones and it might be that these made in thinner sections would prove to be a better solution than even glass or plastic but he had no information on these.

Mr. A. H. Barrington (Manchester) said that for many years they had tried pyrex glass in heat exchangers. Initially trouble had been experienced due to fracture of the glass jointing material used which would not stand up to the liquor, and by the process of elimination they had found a rubber compound which would. Breakage on U bends was experienced due to expansion and contraction of the plant when it went on and off; but by breaking the U to a 45° bend instead of 180° they got a considerable life out of the tube.

Mr. Lord said he had had no experience of the use of pyrex or oven glass, but even so he did not think it would do at Stockport, where the liquor plant hung almost over the river and if the glass broke and the liquor escaped it would go straight into the river.

Mr. D. W. Kay asked Mr. Lord for the percentage of fixed ammonia in 1.35; the ammonia was good but he wondered what would happen if that figure was to fall. If this should happen there did not seem to be much latitude on the volume of liquor the Corporation were prepared to accept unless a bigger volume was accepted rather near the margin.

Mr. Lord replied that the latest figure for fixed ammonia was 0.36% and he did not see why there should be a substantial fall in the content of the free ammonia going forward. The tests on which the plant design had been based had been taken over a long period.

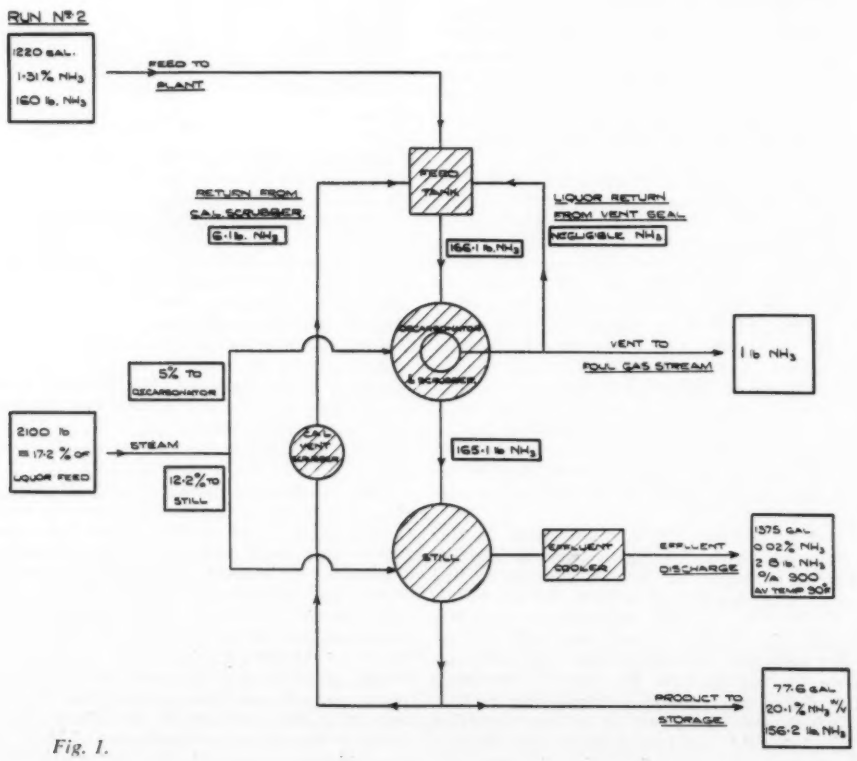
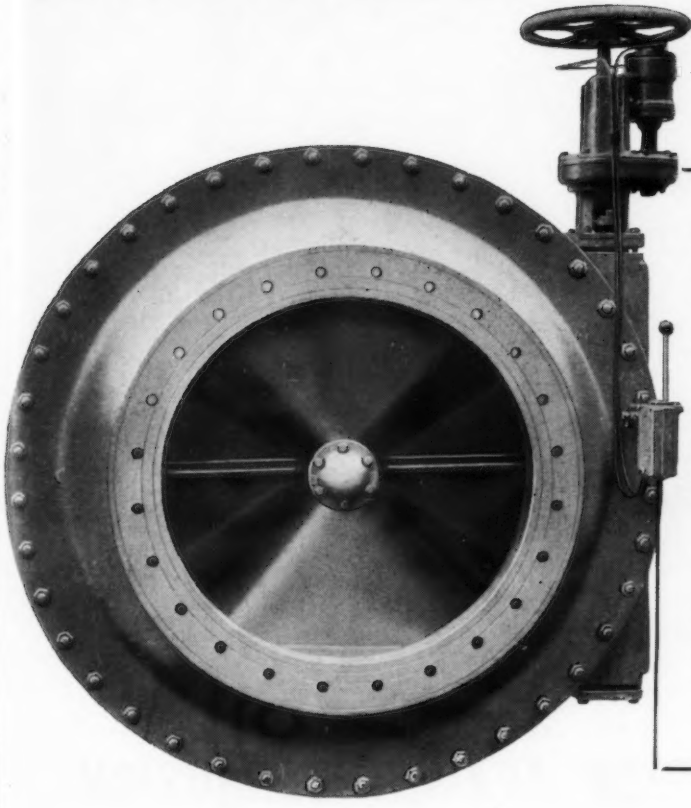


Fig. 1.

POWER OPERATED VALVES

FOR PURIFIERS AND CONDENSERS



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THE COLLIN COKE OVEN

Described in this extract from a paper presented to the Coke Oven Managers' Association by

M. S. GASKILL
M.Inst.Gas E., F.C.S., M.Inst.F.

THE Collin coke oven system may be said to have originated in Belgium, in which country a number of designs of coke ovens have evolved, since it was in Belgium that Franz Josef Collin was born. He was the son of the owner of a coke oven construction company and was therefore, from an early age, closely connected with the industry.

During the period of the great industrial development of the Ruhr he founded a coke oven construction company in Essen in 1869, which was subsequently transferred to Dortmund, the present headquarters of the company.

In the year 1917 Franz Josef Collin was succeeded by his son, Max Collin, and the present organization, F. J. Collin A.G., was formed. Max Collin was in turn succeeded by his sons Mr. Rolf Collin and Dr. Horst Collin and the company is now under the directorship of the former, Dr. Horst Collin having died a few years ago.

In 1953 an agreement was entered into between F. J. Collin A.G. and West's Gas Improvement Company, of Manchester, by which the latter undertook the construction of the Collin system of coke ovens in the United Kingdom.

This system is described in German as the Vollstromwechselofen. It is, however, believed that a literal translation into English, namely 'Full stream reversing oven,' does not adequately convey the idea of the underlying principle of the system. Before, therefore, proceeding to a more detailed description of the Collin coke oven I propose to outline briefly the system of heating on which the name of Vollstromwechselofen is based and which is, it is believed, unique to the Collin installation.

It is fundamental to any type of carbonizing plant that the whole area of the walls of the carbonizing chambers through which heat is to be transmitted from the combustion chambers or flues to the coal charge within the chamber should be at an even temperature. This objective can be obtained by ensuring that the heated wall is subjected at all times to constant combustion conditions, preferably what has been described as 'primary combustion,' i.e., combustion of the fuel gas with the correct amount of secondary air in one stage only. It is well known that a very high proportion of the energy resulting from the combustion of a gas is evolved at the point of combustion. Lecocq (*Les Feurs à Coke*) estimated that in a coke oven 94% of the heat of combustion is transferred to the walls of the up-going chamber in which initial combustion takes place and only 6% in the down-coming chamber. It is certain, too, that the evolution of heat in a primary combustion takes place at a very much greater rate than in any secondary combustion where additional air is added to extend combustion over a longer combustion chamber, as in some designs.

This principle has been applied in the balanced heating design of Glover-West continuous vertical retorts resulting in considerable reduction in fuel consumption. With regenerative heating and under conditions obtaining in coke ovens the desired condition of even temperature distribution is not as readily attained.

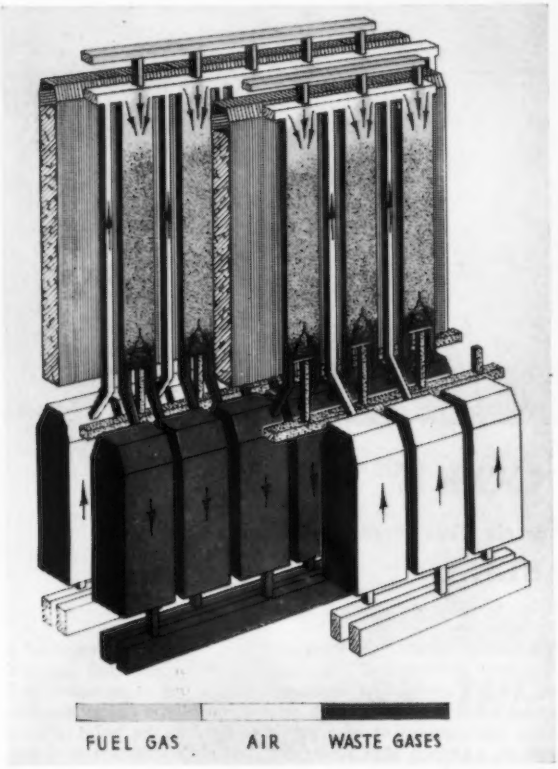
In the system under consideration the development of the method of heating has made possible the use of direct heating by primary combustion of the maximum area of the oven wall. This is affected by direct combustion of the fuel gas at all times in each combustion flue or chamber, the fuel gas and secondary air supply being admitted at the bottom and top of every combustion flue alternatively at each change of cycle.

This is achieved by the construction of the vertical division wall within the heating flue with hollow tiles. These hollow tiles form vertical flues through which the waste gases pass downward or alternatively the secondary air and producer gas pass upwards.

Briefly described, the system is as follows: After passing upward through half the regenerators the preheated air and gas combine at the base of the heating flues, thus heating every combustion flue in an upward direction. From the top of the

combustion flues the waste gases pass downwards through the flues formed by the hollow tiles of the division walls to the other half of the regenerators. After reversal, during the second period of the cycle the air and gas, after passing through the regenerators heated during the first period, pass upward through the division wall flues. The air and gas meet at the top of the combustion flues each one of which is during this part of the cycle heated in a downward direction.

The above refers to heating with producer gas. When coal gas is used as the fuel gas the procedure is similar except that in this case the secondary air only passes through the regenerators, the fuel gas being supplied alternately to horizontal flues located at the top and bottom of the combustion flues.



Downward heating by coke oven gas (rich gas).

Before describing in more detail the construction and operation of the Collin oven it may be of advantage at this stage to outline the salient points of the system, which are:—

(1) Even heating of the chambers. It is claimed that uniform heating of the walls can be obtained with chambers up to 6 metres high.

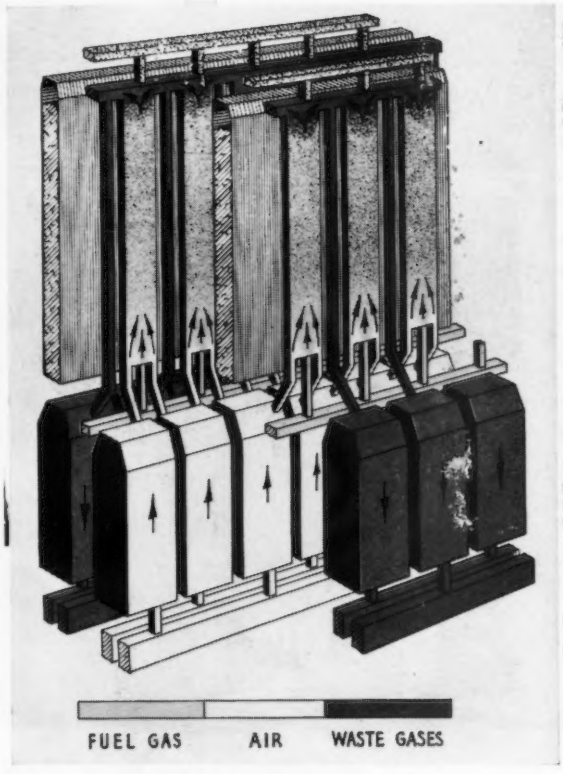
(2) Avoidance of excessive local heating giving greater safety and, in conjunction with the even temperatures, reduction of stress in the refractory materials.

(3) Consistent 'coking' characteristics throughout the charge.

(4) Due to even temperature distribution, minimum combustion flue temperatures are required for a given coking time thus ensuring economy in fuel.

(5) Overheating of the gas collection space at the top of the oven cannot occur. Thus degradation of the make-gas and formation of excessive naphthalene are avoided. By suitable regulation the heat at the top of the oven may be adjusted to maintain correct conditions to comply with the characteristics of the coal to be carbonized, e.g., shrinkage over a wide range.

(6) Stability and strength of the oven walls. The construction of the vertical division walls of hollow tiles, or to use the equivalent of the German description 'binders,' which also form an integral part of the oven wall, gives an extremely robust arrangement. The oven has considerable structural resistance to deformation and is suitable for the carbonization of high swelling coals. Moreover, the profile of the flue formed



Upward heating by coke oven gas (rich gas).

by the 'binders' increases the transmission of heat by radiation to the walls of the oven.

(7) The distance travelled by the heating or waste gases is reduced to a minimum. As a result, pressure differentials are reduced and the risk of leakage through refractory walls is minimized.

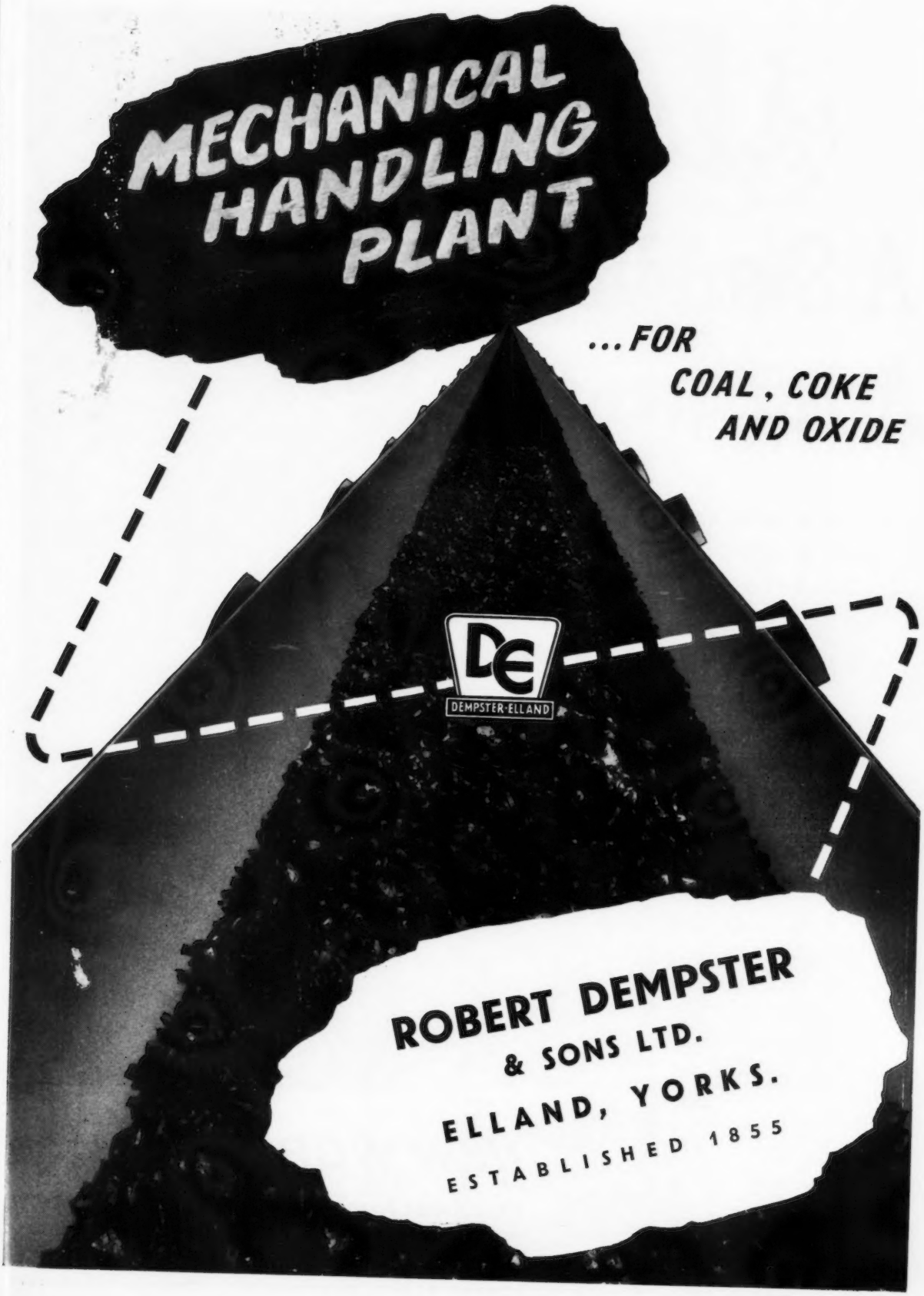
(8) The regenerators are of an individual or 'box type' construction. This not only facilitates accurate control of air and gas to the combustion chambers but greatly reduces risk of by-passing and leakage.

Construction of the Ovens

The number of 'lines' of regenerators in a battery is always two more than the number of ovens, i.e., a regenerator is arranged below each oven plus two extra regenerators, one below each end of the battery. Each line of regenerators consists of a series of individual or 'box type' units. The number of units in each regenerator exceeds the number of combustion chambers on any one side of an oven by one. Thus, in an installation where there are 24 combustion chambers between each pair of ovens, each regenerator comprises 25 units. When the installation is being fired with lean or producer gas, 13 of the units are used for pre-heating air and 12 units for pre-heating gas. Alternate units are used for air and gas so that the outer units are always used for air. All the units in alternate regenerator lines are, of course, receiving hot waste gas.

In the case of rich or coal gas underfiring all the units in alternate lines are either preheating air or receiving waste gas. The coal gas supply for heating is introduced through horizontal passages at the top and bottom of the ovens.

The regenerator units are fitted with a special design of chequer work in addition to which the walls of the units also enter into the regenerator process. The interior of the regenerators can be inspected and any soot or dust deposits blown out. The regenerator assemblies can be dismantled and reconstructed without disturbance of the oven structure. Coal gas supply for underfiring is supplied to both ends of the horizontal distributing flues, previously mentioned, by external pipes housed within the buckstays. The coal gas supply to individual combustion chambers is regulated by the use of readily interchangeable nostril plugs.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In order to amplify the description of the heating system already given and to give a clear picture of the method of operation, a brief description follows of the sequence of events and the route of the combustion gases during the heating cycle when employing either producer gas or coke oven gas as fuel.

Heating with Producer Gas

Below each line of regenerators there are two flues which can supply the regenerator units either with gas or air introduced from one end of the flues, or can draw off waste gas from the regenerators and pass it to the main waste gas flue through valves at the opposite ends of these flues. Each line of regenerators operates in conjunction with an adjacent line. It should be noted that adjacent lines of regenerators are different with respect to their connections to the heating (or combustion) flues. Whereas one line is connected, via slots and burner nozzles, to the base of the heating flues for admission of air or gas during the first (or 'upward heating') period, or for withdrawal of waste gas during the second (or 'downward heating') period, the adjacent line is connected to the top of the heating flues, via the hollow division wall flues, for withdrawal of waste gas during the first period or admission of air or gas during the second period.

(*a*) *First Period—Upward Heating.*—During this period the waste gas valves situated at one end of a pair of flues are closed. At the other end air enters through the open air valve into one flue, while lean or producer gas, from the gas distribution pipe, enters the other flue via a three-way cock and gas-inlet pipe. Passing through the adjustable flue inlets gas and air enter separate units of the regenerators where they are both preheated. Passing upward through slots and nozzles they enter the base of the heating flue. Combustion then takes place in an *upward direction* in the heating flues. The waste gases pass from the top of all the units of the adjacent line of regenerators. Thence the waste gas passes along both flues below these regenerators through the waste heat valves and into the main waste-gas flue.

(*b*) *Second Period—Downward Heating.*—By means of the reversing mechanism the open/closed position of air valves, gas three-way cocks and waste-heat valves are reversed. Air and gas now enter alternate units of the regenerator which was in the first period heated by the waste gas. The preheated air and gas now pass upward through the hollow division walls and are delivered to the top of the heating flues. Combustion now occurs in a *downward direction.* From the base of the heating flues the waste gas passes through the burner nozzles into all the units of the generator, which had in the first period preheated the gas and air, and thence through the respective flues and the open waste gas valves into the main waste gas flue.

Heating with Coke Oven Gas (Rich Gas)

In this case, of course, the fuel gas is not preheated in the regenerators but passes directly through calibrated and interchangeable nostril plugs into the heating flues. All regenerator units are therefore used for preheating air.

(*a*) *First Period—Upward Heating.*—From the gas distribution pipes situated on both sides of the battery the coke oven gas is fed through three-way cocks and gas inlets into the horizontal gas flue at the base of the ovens and from there through the nostrils into the base of the heating flues.

Air passes through the air valves into the two flues below a line of regenerators and enters all the units of the regenerator through the control nozzles. After preheating, the air passes through the inlet ports into the base of the heating flues where it meets the gas and combustion takes place in an *upward direction.*

(*b*) *Second Period—Downward Heating.*—From the distribution pipes the coke oven gas passes via the three-way cocks and gas inlets into the horizontal gas flues in the upper part of the battery, hence down through the control nostrils into the top of the heating flues.

The air enters through the two flues below the regenerator previously heated by the waste gas and passes upward through all the units of this line of regenerators. These units are connected through the hollow division walls to the top of the heating flues and the air is thus delivered to the tops of these flues so that combustion takes place in a *downward direction.*

The waste gas leaves the base of the heating flues and passes into a line of regenerator units and thence through the two flues, below this line, into the waste gas flues via the waste gas valves.

Typical Dimensions

Ovens of various sizes to meet clients' requirements have been constructed. As a general indication the following figures give the various dimensions of a typical modern oven:

Length of oven between doors	41 ft. 8 in.
Height of oven	14 ft. 9½ in.
Mean width of oven	1 ft. 5½ in.
Centre of ovens	3 ft. 9¼ in.
Taper of ovens	2⅜ in.

Dry Cooling of Coke

A description of the Collin oven without reference to this feature would be incomplete. A series of brick-built chambers are arranged at the discharge side of the ovens. One cooling chamber is usually provided for every three coke ovens. Each chamber is provided at the top with a gas-tight charging door, below which is a form of 'step grate,' set at such an angle that when the coke discharge door on the front of the cooling chamber opens the coke is readily discharged by gravity.

A 'cold' inert gas inlet is provided on the front of the cooling chamber. The hot inert gas is withdrawn through an outlet at the back of the chamber above the coke level. Valves for control of cold and hot gas are provided.

Some indication of the heat distribution and recovery in the system may be obtained from the following approximate figures:

Taking heat in coke as charged into cooling chambers at 960°C. as	= 100
Then sensible heat retained in coke as discharged from cooling chamber at 250°C.	= 18%
Losses due to radiation, etc.	= 9%
Sensible heat in hot gas at boiler inlet	= 73%

To give the above results the volume of waste gas in circulation would be about 3,500 cu.ft. per ton of coke. The amount of steam which would be raised would, of course, depend on boiler efficiency, steam pressure, temperature of feed water, etc., but under average conditions this would be of the order of 850 to 900 lb. of steam per ton of coke cooled.

SUPPLEMENT TO FIREGUARDS STANDARD

SINCE October, 1953, statutory regulations issued under the Heating Appliances (Fireguards) Act of 1952 have made it compulsory for all electric, gas, and oil-burning heaters to be fitted with safety guards which satisfy the requirements of British Standard 1945. The requirements specified in the regulations, which are based on those in the British Standard, deal with the construction, fitting and testing for effectiveness of such guards.

Difficulties in interpreting some sections of the standard and thence in observing the regulations have been experienced both by manufacturers of heating appliances and by local government inspectors, whose responsibility it is to see that the Fireguards Act is properly complied with.

To help in avoiding such difficulties in the future the Committee which prepared B.S. 1945 has, with the help and approval of the Home Office, now produced a supplement to the standard. The supplement consists of a series of notes and three appendices which have to be read in conjunction with the original B.S. 1945.

Among other things, the notes explain what is meant by the phrase 'maximum rate of burning' of the heating appliance for each of the three fuels concerned (electricity, gas and kerosene), and details are given regarding the conditioning of the strip of flannelette prior to the test for the effectiveness of the guard. A statement is also made which should help towards a clearer understanding of the term 'smoulder.'

The clause in B.S. 1945 dealing with the application to fireguards of the B.S.I. approvals mark (the 'Kite') has been deleted, as marking requirements are included in the individual standards covering the complete heating appliance, namely, B.S. 1250—'Domestic gas appliances,' B.S. 1670—'Safety requirements for electric fires,' and B.S. 2049—'Kerosene appliances for Domestic Use.'

Liquid Gas . . . an investigation

By JOHN D. CRECCA, Jnr.

(*Continued*)

PART V.

Fiscal Analysis of the Proposed System

THE gas consumption in Philadelphia in 1951 by months according to J. W. Carrol in his article on peak gas loads[10] is given as follows (in terms of mill. cu.ft.): January, 1,690; February, 1,565; March, 1,496; April, 1,054; May, 834; June, 700; July, 637; August, 701; September, 778; October, 1,088; November, 1,793; December, 1,072.

This gives a total of 14,408 mill. cu.ft. per year. To deliver this amount, slightly less than seven ships are required if they burn methane fuel between Venezuela and Philadelphia. Seven ships can deliver 15,960 mill. cu.ft. per year or 1,310 mill. cu.ft. per month. From these figures, the monthly balance may be found.

TABLE V.

	Jan.	Feb.	Mar.	Apr.
Consumed	1,690	1,565	1,496	1,054
Delivered	1,310	1,310	1,310	1,310
Net	−380	−255	−186	256

	May	June	July	Aug.
Consumed	834	700	637	701
Delivered	1,310	1,310	1,310	1,310
Net	476	610	673	609

	Sept.	Oct.	Nov.	Dec.
Consumed	778	1,088	1,793	2,072
Delivered	1,310	1,310	1,310	1,310
Net	532	222	−483	−762

gross excess 3,378 mill. cu.ft.
gross deficit 2,066 mill. cu.ft.

net excess 1,312 mill. cu.ft. or 8.4% of total delivery

total number of tanks needed if one tank holds 88.3 mill. cu.ft.

$$\frac{3{,}378 \text{ mill. cu.ft.}}{88.3 \text{ mill. cu.ft.}} = 38.2$$

Using two stand-by storage tanks at the liquefaction plant, a total of 40 is required. It should be noted that while these values do not give the gas consumption for the whole Philadelphia area, these values are indicative of seasonal variation.

Several combinations of sources of supply and points of consumption were chosen. The fields of the Near East were not considered because Venezuela and Texas provided sources closer to the chosen port of delivery, Philadelphia. The computations for the transportation costs to Southampton were included to give some idea of the magnitude of the delivery costs from Western Hemisphere sources. Two other variables have been included in the transportation costs. There are the use of American or foreign crews and the burning of bunker C oil or methane as fuel. By referring to Table VI, it may be seen that the best results are obtained by using foreign flag ships burning methane for fuel between Venezuela and Philadelphia. A new credit of $2.523 per trip or a credit of $244,770 per year is obtained from the seven required ships.

Each ship will cost $3,600,000 giving a total cost of $25,200,000. This includes the cost of purchasing and converting. Under the conditions chosen, the yearly cost which includes port charges, operating costs, and depreciation, based upon a 10 year life, will be $5,492,630.

TABLE VI

Case 1.—**American Flag Operation from Galveston to Philadelphia,** Distance 1,866 miles at 15.5 Kts=120.4 hours=5 days at sea, 12 day round trip (allowing one day for loading and one day for Unloading) or 30.4 trips per year.

	Using Bunker C Oil Fuel.	Using Methane Fuel.
	$	$
Total Operating Cost	38,560	32,560
Credit for Transportation of 9,620 tons Cargo Oil at 1.50 per 1,000 miles per ton = 1.8666 × 1.50 × 9,620 =	26,928	26,928
Net Cost Transporting	11,632	5,632
Total Liquid Methane Transported =	883,200 Therms	717,116 Therms
or 883,200 − 22,080 = (.5% loss/day).	860,120 Therms	
Transportation Cost/Therm	$.0135	$.0078

Case 2.—**American Flag Operation: Galveston to Southampton**—4,810 miles a 15.5 Kts. = 310 hours =-13 days, round trip in 28 days, allowing one day for Loading and one day for Unloading. Computation on trip basis, 13.5 trips per year.

	Using Bunker C Oil Fuel.	Using Methane Fuel.
	$	$
Total Operating Cost	90,200	74,600
Credit for Transportation of 9,620 tons Cargo Oil 4,810 miles at 1.00/1,000 miles/ton = 9,620 × 1.00 × 4.81	46,272	46,272
Net Cost of Transporting	43,928	28,328
Methane Transported-Start	883,200 Therms	883,200
less Loss 4,416 therms/day × 13 days	57,408 Therms	431,818
	Fuel	
Net Methane Delivered	825,792 Therms	451,382
Transportation Cost per Therm	$0.532/Therm	$0.627/Therm

Case 3.—**American Flag Operation: Venezuela to Philadelphia,** Distance 1,835 miles—118 hours—4.8 days—Round Trip in 11.6 days allowing one day for Loading and one day for Unloading. Computed on Round Trip basis, 33½ round trips can be made in a year in this case as compared to Case 1.

	Using Bunker C Oil Fuel.	Using Methane Fuel.
	$	$
Total Operating Cost	37,217	32,335
tons Cargo Oil $1.50 per 1,000 miles per ton 9,620 × 1.5 × 1.835 =	26,478	26,478
Cost to Transport Methane	10,739	5,857
Methane Delivered:		
Total Methane Load at Start	883,200 Therms	883,200
Loss by Evaporization	21,197	159,441
Net Methane Delivered	862,003 Therms	723,759
Cost to Transport per Therm	$.0125	$.0081

Case 4.—**American Flag Operation: Venezuela to Southampton,** 4,363 miles miles at 15.5 = 281 hours = 11.7 days or one round trip in 25.4 days (allowing one day for Loading and one day for Unloading). Estimate based on single round trip. 14.4 trips per year.

	Using Bunker C Oil Fuel.	Using Methane Fuel.
	$	$
Total Operating Cost	82,298	67,960
Credit for Transporting 9,620 tons Cargo Oil 4,363 miles at 1.00 per 1,000 miles/ton, 9,620 × 1.00 × 4,363	41,972	41,972
Net Cost to Transport Methane	40,326	25,988
Methane Cargo at Start	883,200 Therms	883,200
Loss due to Evaporization	51,667 (Consumed)	388,637
Net Methane Delivered	831.533 $.0485/Therm	494,563 $.0525/Therm

TABLE VI—*Continued.*

Case 5.—**Foreign Flag—Galveston to Philadelphia.** Not computed as such operation not permitted.

Case 6.—**Foreign Flag Operation: Galveston to Southampton,** Distance, time of round trip, Fuel requirements and other conditions are the same as Case 2 except for Cost of 'Crew's Wages, Subsistence and other operating expenses.'

	Using Bunker C Fuel.	Using Methane Fuel.
	$	$
Total Operating Cost	74,800	59,200
Credit for Transporting 9,620 tons Cargo Oil, 4,810 miles at 1.00/1,000 miles/ton	46,272	46,272
Net Cost Transporting Methane	28,528	12,928
Net Methane Delivered	825,792 Therms	451,382
Transportation Cost Methane	$.0351/Therm	$.0286/Therm

Case .7—**Foreign Flag Operation: Venezuela to Philadelphia,** Distance, time of round trip, Fuel requirements and other conditions are the same as Case 3 except for 'Crew's Wages, Subsistence and other expenses.' For comparison, the following is also computed on one trip basis as in Case 3.

	Using Bunker C Fuel.	Using Methane Fuel.
	$	$
Total Operating Cost	29,804	23,955
Credit for Transporting 9,620 tons Cargo Oil at 1.50 per 1,000 miles per ton	26,478	26,478
Cost to Transport Methane	3,326	Credit
Methane Delivered	862,003 Therms	723,759
Cost to Transport Methane/Therm	$.0038	.000

Case 8.—**Foreign Flag Operation: Venezuela to Southampton,** Distance, time of round trip, Fuel requirements and other conditions are the same as Case 4 except for 'Crew's Wages, Subsistence and other expenses.' Estimate based on single round trip as in Case 4.

	Using Bunker C Fuel.	Using Methane Fuel.
Total Operating Cost	68,320	53,990
Credit for Transporting 9,620 tons Cargo Oil 4,363 miles	41,972	41,972
Net Cost to Transport Methane	26,246	12,018
Net Methane Delivered, Therms	831,533	494,563
Cost to Transport Methane	$.0320/Therm	$.0243/Therm

The initial cost of the shore installation is $29,862,400. This includes the cost of all the fixed equipment such as liquefaction machinery, power plant, storage tanks, and buildings. The depreciation is based upon a capital recovery with a return. A general salvage value of 15% was used on much of the equipment. A 4% compound yearly interest rate is used. The yearly costs, which include fuel, cooling water, maintenance, taxes and insurance are $4,007,300.

In the calculations the cost of the gas as a fuel in the producing area was estimated at 6c. to 8c. per mill. B.Th.U. or 0.6c. to 0.8c. per therm. 'Gas Facts'[21] gives the well head cost of the gas in Texas and Louisiana as 0.62c. per therm and 0.67c. per therm, respectively, in 1952. To be conservative, a figure of 0.8c. per therm at the well head for a gas with a heating value of 1,000 B.Th.U. per cu.ft. will be used. Since the fuel will be consumed in the producing area, it is believed that these rates are reasonable.

TABLE VII.

Summary:

Estimated Shore Costs.

Item.	Initial Cost.	Yearly Cost.
	$	$
Compressors and Expanders	2,690,000	181,500
Power Plant Investment operating cost	3,290,000	587,000
Exchangers	330,400	25,100
Shore Storage Tanks	11,600,000	694,000
Cooling Water	—	607,000
Piping	9,750,000	661,000
Buildings	813,000	45,600
Instrumentation	813,000	55,600
Maintenance	—	813,000
Equipment Supplies	—	113,500
Taxes and Insurance	—	405,000
Total of Shore Costs	$29,862,400	$4,007,300

Estimated Cost to Effect Conversion of Tanker.
The cost is summarized as follows:

	$
Purchase Price of T2 Tanker (American Flag)	750,000
General Overhaul for Reconditioning and Test of Machinery	50,000
Methane Storage Tanks including insulation	1,890,000
New Inner Bottom and Double Bottom Framing	288,000
Insulation on Boundaries of Methane Tank Rooms	362,000
Liquid Methane Pumps and Piping	70,215
Inert Gas Generator System	135,756
Total	3,545,971
Margin	54,029
Estimated Cost per ship	3,600,000
Total Ship Cost	25,200,000

Yearly Ship Costs.

	$
Depreciation on seven ships	3,108,000
Operation costs for seven ships 314 trips	2,174,130
Port Charges	210,500
Total Yearly Cost	5,492,630
Credit for Wing Tank Cargo	−5,737,400
Yearly Credit on Ship Operation	244,770

Net Cost of Overall Operation.

	$
Shore Operation	4,007,300
Ship Operation (Credit)	244,770
Net	3,762,530

Total Initial Investment.

	$
Ships	25,200,000
Shore Facilities	29,862,400
Total	55,062,400

Unit Cost of Gas Cargo.

Total Cargo Delivered 15,960 mill. cu.ft. per year or 157.6 mill. Therms.

$$\text{Cost/Therm delivered} = \frac{\$\ 3,762,530}{157,600,000} = 0.0239/\text{Therm}$$

Total Cost.

	$
Well Head	0.0080/Therm
Transportation	.0239
Total	0.0319/Therm

PART VI.

Summary

The cost of purchasing, liquefying, transporting, and storing of the natural gas delivered to Philadelphia is 3.19c. per therm or about 31.9c. per mill. cu.ft. Table VIII presents typical gas prices in different parts of the United States.

TABLE VIII.

Regional Natural Gas Costs per 1,000 Cu.Ft.[22]

Consumer Region.	Field Price.	City Gate Price.	Residential Price
	$	$	$
New England	0.08	0.52	2.61
Middle Atlantic	0.13	0.34	1.28
South Atlantic	0.13	0.28	0.84
North Central	0.09	0.27	0.82
Pacific	0.14	0.26	0.73
Mountain	0.07	0.20	0.62
Average	0.11	0.28	0.91

Since Philadelphia may be considered 'Middle Atlantic,' one may see by comparing the city gate price of pipeline gas to that of the proposed system, they are both about the same. Therefore, it would seem that further investigation would be worth while.

A closer examination of the constituents of the cost figure of the proposed system indicates that this cost figure is very conservative. The liquefaction system is based upon an incoming gas pressure of 60 per sq. in. This is extremely low when one considers the fact that a large portion of wells come in at pressures of between 1,000 per sq. in. and 2,000 per sq. in. and are operated at pressures of 500 per sq. in. and 600 per sq. in. However, it is also a well known fact that many of these well pressures drop off at such a rate that there have been numerous investigations into portable natural gasoline plants over the past 25 years.[23] Thus, the power cost of compressing the natural gas will not be as high as the estimate if gas is available at high pressures. The system could easily be adapted to high pressure gas by the use of a turbo-expander whose power could be used for the nitrogen compressors. On the other hand, the system would not be rendered inoperative by a low pressure gas delivery (e.g., Fig. 2, June 20, p. 902).

A second advantage of the proposed system may be found in the storage facilities. The problem of providing for winter peak loads has always plagued the gas industry. At present there are four methods of providing for peak loads. They are: (1) increasing pipeline pressure; (2) looping; (3) Underground storage; (4) Manufactured gas. The first and second

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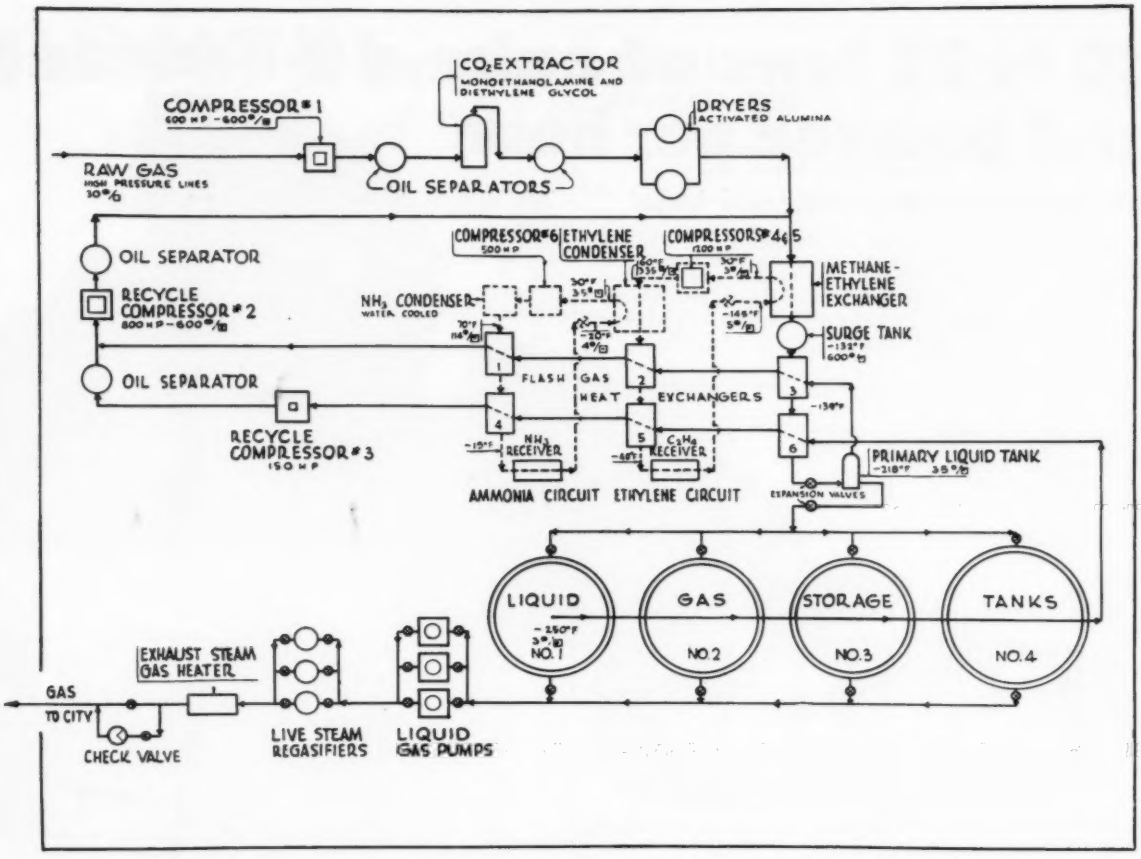

Fig. 7.

methods are either inadequate or too expensive in many cases. The third method is dependent upon the geology of the adjacent area. Some areas have abandoned gas wells that may be used for storage. In other areas certain underground areas may be coated to obtain storage space. The cost of manufactured gas is higher than natural gas. It runs from about 7 cents per therm for coke oven gas to 25 cents per therm for water gas.

The use of surface storage in the proposed design eliminates the above difficulties. Enough storage facilities for surface storage have been provided to allow for an even monthly delivery (see Table V). The summer excess provides for the winter peak demands but does not require large storage areas or special geological conditions. The evaporation loss for the tank used in the proposed design is about one-half of one per cent. per day. The daily demands would be much higher than this.

A third factor to consider when comparing the cost of gas by liquefaction with the present cost is the bases of the design. It has been stated previously that methane was used as a design basis because of ease of access to thermodynamic properties and a desire for conservativeness. Since most natural gases have heavier hydrocarbons (see table III) which will increase the boiling point, the liquefaction costs in actual practice will probably be less. However, temperatures in the neighbourhood of − 250° will be required (see Fig. 7).

Still another cost reducing aspect of the proposed design is the use of the regasification operation to cool another substance. An example of such a use would be the cooling of air that is to be liquefied and separated into oxygen and nitrogen. These gases could then be sold commercially or used in a petrochemical plant that could also use the natural gas.

Before the proposed process can be put into operation, further examination of the many physical and economic aspects should be made. From the physical point, there are at least five items that need further investigation. They are: (1) Standards for metal and welding to withstand such low temperatures; (2) methods to field test these welds; (3) the best type of insulation (e.g. polystyrene plus balsa wood, polystyrene surfaced with a glass-epoxy resin combination for toughness, the new isocyanates, etc.) to withstand thermal shock, liquid penetration, and sheer; (4) a binder that will withstand the thermal shock and is not soluble in the liquefied gas; (5) shipping standards. Undoubtedly, if this or a similar design is undertaken, other problems will arise as does in any other process. However, the above five, at present, seem to be the most outstanding.

The cost factors of the proposed design could present a complex picture. Each cost factor varies in a different manner with the size of the operation. The cost of the ships will vary differently than will the liquefaction equipment with the volume of gas processed. The possibility of alternating between South America and North America according to seasonal demands will effect the tankage requirements for peak loads. Thus, by evaluating the effects of such items as volume of trade, distance to market, and alternate markets, an optimum operating level may be obtained. Today, with the extensive use by many firms of automatic computing machines, it is possible to construct a mathematical model that would give these optimum conditions.

The final conclusions of this investigation are: (1) The proposed system under the worst conditions equals the present system of pipeline transmission; (2) certain physical research is needed to perfect the system (it should be noted that the objectives of this research are well within practical limits); (3) a mathematical model of the system should be made to find the optimum operating level.

[19] Carrol, J. A. 'Economics of Peak Gas Loads,' American Gas Association, 1951.

[20] Burrell and Robertson, 'Compressibility of Natural Gas and Its Constituents,' United States Bureau of Mines Technical paper 158, 1917.

[21] 'Gas Facts,' American Gas Association, Bureau of Statistics, 1953.

[22] Ralph, H. D. *Oil and Gas Journal*, Vol. 54: pp. 162-163, July 25, 1955.

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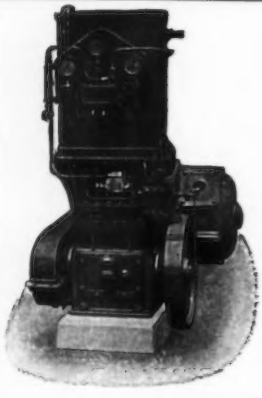

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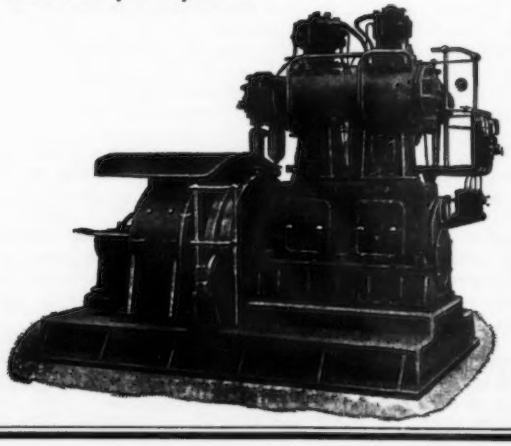

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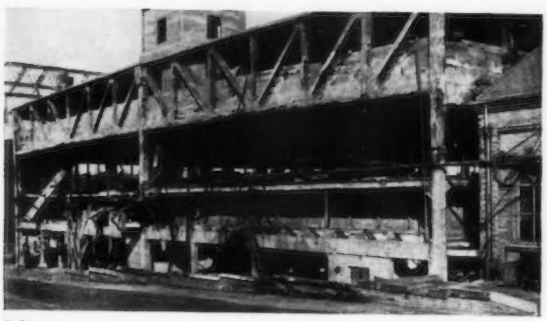

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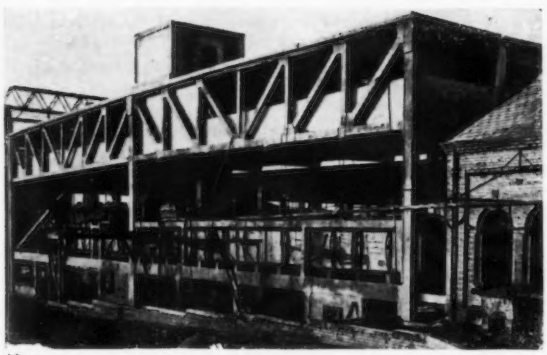

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The " Gas Journal " is published every Wednesday, price 1/6d.; by post 1/8d.

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Classified Advertisements: All small classified advertisements are charged at 2/6 per line (approx. 7 words)—minimum charge 10/-. A Box Number address occupies 2 lines, and a further 6d. is charged towards cost of postage on replies. Copy must be received by first post on Monday to ensure insertion in that week's Journal.

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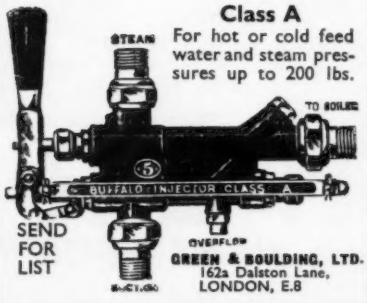

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APPOINTMENTS VACANT

ASSISTANT SECRETARY (Male) required immediately by Trade Association connected with the coal tar industry. Office control, accounts, membership, statistics, trade journal, etc. Commencing salary about £700 p.a. according to experience and ability. Optional 5 per cent. contributory Pension Scheme. Apply by confidential letter to the Secretary, B.R.T.A., 9, Harley Street, London, W.1.

RESEARCH OFFICERS required for recently formed Heating and Ventilating Research Council at their Leatherhead, Surrey, Laboratories. This Council receives the support of the Department of Scientific and Industrial Research. Excellent opportunities for advancement. Superannuation. Five day week, first rate facilities.

Assistant to Chief Research Officer.

Degree in Physics or Engineering with some knowledge of heat transfer and fluid flow. Starting salary up to £1,100 p.a. depending on qualifications and experience.

Research Officer.

Graduate standard, preferably with knowledge of instrumentation. Starting salary within range £700-£900.

Write giving full details to:—c/o. Secretary, Messrs. Andrew W. Barr & Co., 9, Clarges Street, London, W.1.

W. C. HOLMES & CO., LTD., Engineers, Huddersfield, have vacancies on their staff as follows:—

(1) CHEMICAL ENGINEERS holding a degree in Chemistry, Gas or Chemical Engineering, or Associate Membership of the Institution of Chemical Engineers.

(2) TECHNICAL ASSISTANTS having had at least two years' experience in the testing, control and operation of gasworks or chemical plant. Chemical or gas engineering qualifications would be an advantage.

Both posts offer a wide and interesting field which will include the commissioning of contract plants installed by the Company and the operation of pilot plants, and will involve some travelling. One Chemical Engineer will be transferred after an initial period to the design staff. Salary according to experience and qualifications. Generous pension and insurance scheme. Applications giving full details should be sent to J. J. Priestley, W. C. Holmes & Company Ltd., Research and Development Department, Whitechapel Road, Cleckheaton, Yorks.

NORTHERN GAS BOARD

TEES-SIDE DIVISION
ENGINEERING DRAUGHTSMAN

APPLICATIONS are invited for the position of ENGINEERING DRAUGHTSMAN at Middlesbrough.

The salary will be in accordance with Grade A.P.T. 8 of the National Salary Scales (£710-£790).

The successful applicant will be required to pass a medical examination and be subject to the provisions of the Board's Staff Pension Scheme.

Applications, stating age, qualifications and experience should be addressed to the undersigned to arrive not later than first post July 28, 1956.

JOHN W. PALLISTER,
Divisional General Manager.

P.O. Box No. 4,
Gas Works,
Commercial Street,
Middlesbrough,
Yorkshire.

July 10, 1956.

APPLICATIONS are invited for the position of COKE OVEN MANAGER at the Avenue Carbonisation and Chemical Plant, near Chesterfield.

Applicants must have first rate qualifications and experience of large modern Coking Plant.

Salary according to qualifications and experience.

Applications to:—The Staff Director, National Coal Board, East Midlands Division, Sherwood Lodge, Arnold, near Nottingham, within 14 days.

Please mark envelopes and applications S.V. 591.

NORTH EASTERN GAS BOARD

HULL GROUP
HORNSEA DISTRICT
DISTRICT ENGINEER AND MANAGER

APPLICATIONS are invited for the above position at a salary within Grade A.P.T. 9 (Provincial 'B') (£740-£840 per annum) of the Salary Scales agreed by the National Joint Council for Gas Staffs.

The output of gas at Hornsea District is 46 million cu.ft. per annum.

The successful applicant will be responsible for the administration, gas production, sales and distribution of Hornsea District under the general supervision of the District Engineer & Manager, Bridlington, with which district Hornsea is linked for administration purposes.

A suitable house on rental is available adjacent to the Works.

The successful applicant will be required to pass a medical examination and to join the Board's Staff Pension Scheme.

Applications giving age, qualifications and details of experience should reach A. L. Higham, Esq., Group General Manager, North Eastern Gas Board, Bankside Works, Sculcoates, Hull, within 14 days of the appearance of this advertisement.

J. C. GARDNER,
Secretary.

NORTH WESTERN GAS BOARD

GROUP TRAINING AND EDUCATION OFFICER

APPLICATIONS are invited for the pensionable appointment of GROUP TRAINING and EDUCATION OFFICER to the Board's Liverpool and Wirral Groups. The commencing salary will be not less than £1,360 per annum.

Qualifications which are desirable, but not essential, are a degree, preferably in science or technology, corporate membership of a professional institution, technical college teaching experience and responsible experience in industry, preferably in the gas industry or in the field of industrial training.

Further particulars, including details of the responsibilities of Group Training and Education Officers, may be obtained from the Secretary, N.W.G.B., 60, Whitworth Street, Manchester, 1, to whom applications should be returned by August 7.

MANCHESTER GROUP

ENGINEERING DRAUGHTSMAN—CENTRAL DRAWING OFFICE, GAYTHORN

APPLICATIONS are invited for the above pen- sionable appointment within Grades A.P.T. 6/8 (£610/£790 per annum).

Applicants should possess a sound engineering training and be experienced in the design and construction of gasworks or chemical plant, including building construction, steel structures, foundations, etc. Experience in the design and layout of steam, electricity and water services would be an additional advantage.

Detailed applications giving the names of two referees should reach the General Manager, N.W.G.B., Manchester Group, Town Hall, Manchester, 2, within 14 days.

APPOINTMENT OF CHIEF DRAUGHTSMAN

NORTH WEST GAS & CHEMICAL ENGINEERS require the services of a CHIEF DRAUGHTSMAN age about 35 years.

The appointment is an important one and will carry appropriate remuneration.

Applicants must have had experience in the gas industry and a knowledge of associated chemical plant and will be required to take charge of staff dealing with design, estimating and detail work. Membership of recognised technical institutes would be advantageous.

This is a pensionable position and successful candidate would have the opportunity of further advancement.

Assistance will, if required, be given towards finding suitable accommodation.

Apply, stating age, full particulars of experience and present salary to No. 288, *Gas Journal*, 11, Bolt Court, Fleet Street, London, E.C.4.

SCOTTISH GAS BOARD

GALASHIELS DISTRICT
TECHNICAL ASSISTANT

APPLICATIONS are invited for the above appoint- ment:—

Applicants should have a sound general knowledge of the principles of gas manufacture and distribution practice and must be prepared to learn and apply these principles in any District of the Galashiels Sub Group.

The salary for this post will be within the range A.P.T. 3/5, Provincial 'A' (£390-£655). A small house may be made available at a reasonable rent.

The position is pensionable, and the successful applicant will be required to pass a medical examination.

Applications, stating age, and giving particulars of education, training, experience and qualifications should be addressed to the undersigned to arrive not later than July 31, 1956.

G. C. WOOD,
Sub Group Manager.

Gas Works,
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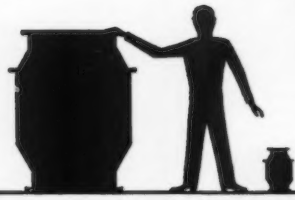
These 'TORNADO' Bifurcated Fans by Keith Blackman remove fumes and inflammable gases at temperatures as high as 350°F., and are now available in sizes up to 48 in. Bifurcated Fans are compactly made, with the motor isolated from all harmful fumes and gases, obviating the need for more expensive axial fan arrangements. Publication No. 28/7 awaits your request.

To dispose of more corrosive fumes you need the SOLID rigid P.V.C. Bifurcated Fan. — ask for details.



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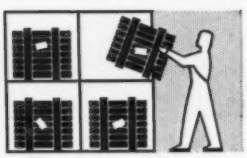

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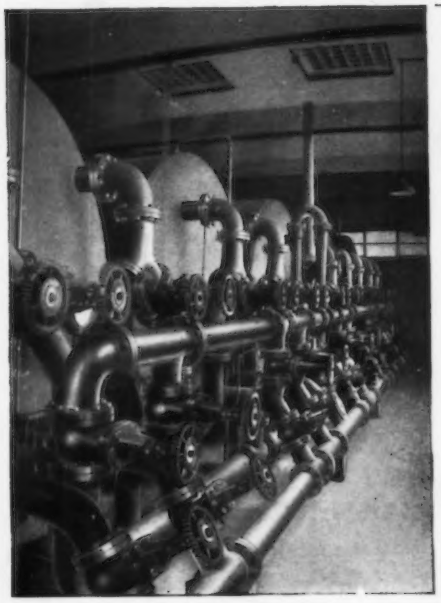

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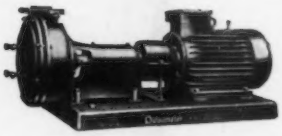
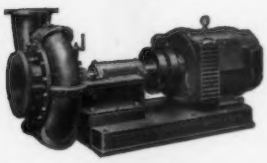
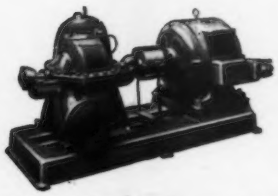


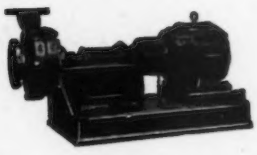
Stoneware pump for Corrosive and chemicals



Slurry pump for coal washing and abrasive liquids.

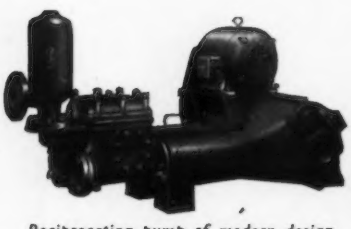


"HS" Type—for water services. All heads up to 500 feet.



"JA" & "JB" types for high temperature water circulation.

The illustrations show centrifugal pumps for light and heavy oil and liquor duties, stoneware and special metal pumps for handling acids and alkalis, pumps for circulating and washer duties, for clean water and fire services and for liquids containing abrasives.



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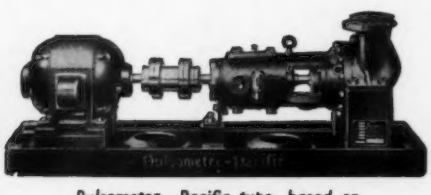
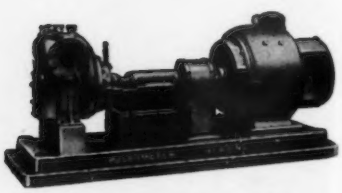


Pulsometer—Pacific type, based on latest American practice.



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